Anatomy: Hip and Thigh



Question 1 of 106

You are teaching hip and thigh anatomy to a group of medical students. The femoral canal contains which of the following structures:

a Femoral vein

b Superficial inguinal lymph nodes

c Deep inguinal lymph nodes

d Femoral artery

e Femoral nerve

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Anatomy: Hip and Thigh

Question 1 of 106

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a) Femoral vein
b) Superficial inguinal lymph nodes
c) **Deep inguinal lymph nodes** ✔
d) Femoral artery
e) Femoral nerve

Answer

The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

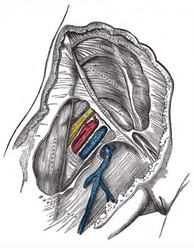
Contents

The femoral triangle contains (from lateral to medial):

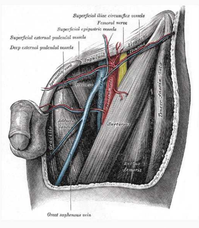
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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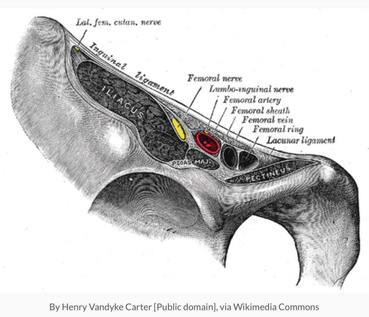
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 2 of 106

A 43 year old man presents to the ED complaining of weakness at the right knee. On examination you note he is unable to extend the leg at the knee joint. Which of the following muscles is the most important in producing extension of the leg at the knee joint:

a Hamstrings

b Quadriceps femoris

c Gracilis

d Sartorius

e Gastrocnemius

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Anatomy: Hip and Thigh

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a) Hamstrings
b) **Quadriceps femoris** ✔
c) Gracilis
d) Sartorius
e) Gastrocnemius

Answer

The quadriceps femoris muscle is the main extensor of the leg at the knee joint.

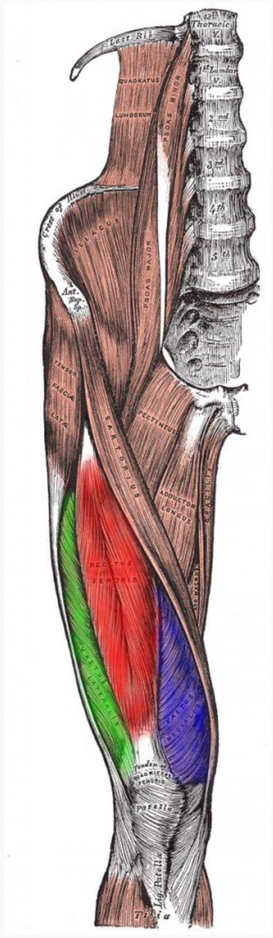
Notes

Muscle	Action(s)	Innervation
Rectus femoris (red)	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)
Vastus lateralis (green)	Extension at knee	Femoral nerve (L2 – L4)
Vastus medialis (blue)	Extension at knee	Femoral nerve (L2 – L4)
Vastus intermedius	Extension at knee	Femoral nerve (L2 – L4)

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. Because the vastus muscles insert into the margins of the patella as well as into the quadriceps femoris tendon, they stabilise the position of the patella during knee joint movement.

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4). A tap on the patella ligament tests reflex activity mainly at spinal cord levels L3/L4.



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Anatomy: Hip and Thigh



Question 3 of 106

A 67 year old man presents to the ED complaining of swelling to the posterior knee. On examination you note a pulsatile mass in popliteal fossa.Which of the following best describes the course of the popliteal artery:

a Begins at the mid-thigh as a continuation of the femoral artery

b Exits the popliteal fossa between the gastrocnemius and plantaris muscles

c After exiting the popliteal fossa terminates at the lower border of the popliteus muscle

d Terminates as the posterior tibial and the fibular artery

e After exiting the popliteal fossa continues down the posterior leg terminating at the level of the lateral malleolus

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Anatomy: Hip and Thigh

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c)

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d) Terminates as the posterior tibial and the fibular artery

e)

After exiting the popliteal fossa continues down the posterior leg terminating at the level of the lateral malleolus

Answer

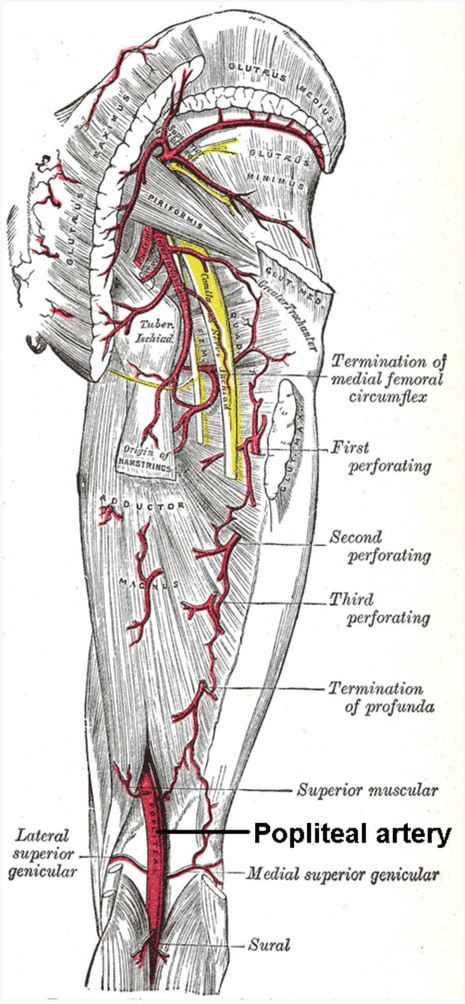
After exiting the popliteal fossa between the gastrocnemius and popliteus muscle, the popliteal artery bifurcates into the anterior and posterior tibial arteries at the lower border of the popliteus

Notes

The femoral artery becomes the popliteal artery after entering the posterior compartment of the thigh through the adductor hiatus just proximal to the knee.

The popliteal artery is the deepest neurovascular structure in the popliteal fossa. Palpation should be performed with the person in the prone position with the knee flexed to relax the popliteal fascia and hamstrings. The popliteal pulse is best felt in the midline, in the inferior part of the fossa where the popliteal artery is related to the tibia.

After exiting the popliteal fossa between the gastrocnemius and popliteus muscle, the popliteal artery bifurcates into the anterior and posterior tibial arteries at the lower border of the popliteus.



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Anatomy: Hip and Thigh



Question 4 of 106

A patient complains of pain in the hip region following a fall. Imaging has shown a traumatic injury to the pectineus muscle. The pectineus muscle acts primarily to produce which of the following movements:

a Flexion and adduction of the thigh

b Flexion and abduction of the thigh

c Extension and medial rotation of the thigh

d Flexion and lateral rotation of the thigh

e Extension of the thigh

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Anatomy: Hip and Thigh

Question 4 of 106

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a) **Flexion and adduction of the thigh** ✔
b) Flexion and abduction of the thigh
c) Extension and medial rotation of the thigh
d) Flexion and lateral rotation of the thigh
e) Extension of the thigh

Answer

The pectineus acts to adduct and flex the thigh at the hip joint.

Notes

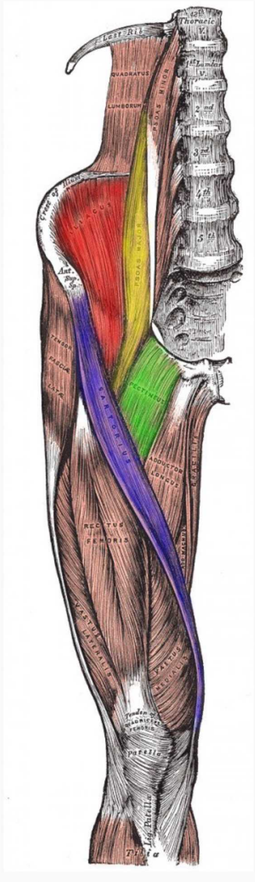
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 5 of 106

You are examining the lower limbs of a 54 year old man who presented after falling from a ladder at home. During your neurological assessment you note a weakness of hip adduction. Which of the following nerves is most important for adduction of the thigh at the hip joint:

a Femoral nerve

b Sciatic nerve

c Superior gluteal nerve

d Inferior gluteal nerve

e Obturator nerve

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Anatomy: Hip and Thigh

Question 5 of 106

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a) Femoral nerve
b) Sciatic nerve
c) Superior gluteal nerve
d) Inferior gluteal nerve
e) **Obturator nerve** ✔

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Answer

Adduction at the hip is primarily produced by the adductor longus, brevis and magnus, all innervated by the obturator nerve. The pectineus and gracilis muscles, innervated by the femoral nerve and obturator nerve respectively, assist in this action.

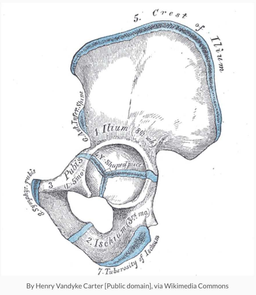
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

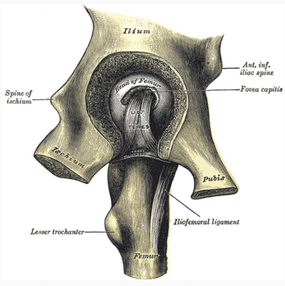


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 6 of 106

A 83 year old lady has sustained a distal femur fracture from a fall down stairs. Your consultant wishes to administer a femoral nerve block. Which of the following landmarks is most accurate for localising the femoral nerve:

a Midway between the anterior superior iliac spine and the pubic tubercle

b Just lateral to the femoral artery pulsation

c Just medial to the femoral artery pulsation

d Just superolateral to the pubic symphysis

e Just medial to the anterior superior iliac spine

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a) Midway between the anterior superior iliac spine and the pubic tubercle
b) **Just lateral to the femoral artery pulsation** ✔
c) Just medial to the femoral artery pulsation
d) Just superolateral to the pubic symphysis
e) Just medial to the anterior superior iliac spine

Answer

The femoral nerve lies just lateral to the femoral artery as it passes posterior to the mid-inguinal point (midway between the ASIS and the pubic symphysis) to enter the femoral triangle in the anterior compartment of the thigh. If a needle is inserted about 1.5 cm lateral to the maximal femoral pulse, it will intersect the femoral nerve in most cases.

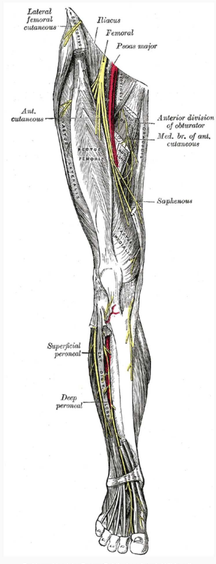
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

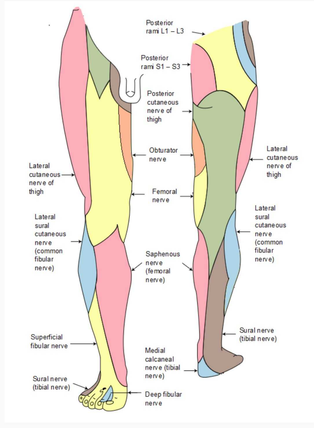
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Question 7 of 106

A patient presents to ED for treatment having been informed by the GUM clinic that he has tested positive for gonorrhoea. You administer intramuscular ceftriaxone. Intramuscular injections in the buttocks should always be given in which of the following areas:

a Upper lateral quadrant

b Lower lateral quadrant

c Upper medial quadrant

d Lower medial quadrant

e Lower medial or lateral quadrants

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Question 7 of 106

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a) **Upper lateral quadrant** ✔
b) Lower lateral quadrant
c) Upper medial quadrant
d) Lower medial quadrant
e) Lower medial or lateral quadrants

Answer

The sciatic nerve passes through the lower medial quadrant. Intramuscular injections in the buttocks should always be given in the upper lateral quadrant of the gluteal region to avoid damage to the sciatic nerve and major vessels in the region.

Notes

The gluteal region can be divided into quadrants by 2 lines: one line descending vertically from the highest point of the iliac crest, the other line passing horizontally through the first line midway between the highest point of the iliac crest and the ischial tuberosity. The sciatic nerve passes through the lower medial quadrant. **Intramuscular injections in the buttocks should always be given in the upper lateral quadrant of the gluteal region to avoid damage to the sciatic nerve.**

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Anatomy: Hip and Thigh



Question 8 of 106

A 21 year old man received a stab wound to the posterior part of his gluteal region. Following resuscitation, he is found to have great difficulty rising to a standing position from the seated position. Which of the following muscles was most likely affected by this injury:

a Quadriceps femoris

b Iliopsoas

c Hamstrings

d Gluteus maximus

e Gluteus medius

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Anatomy: Hip and Thigh

Question 8 of 106

A 21 year old man received a stab wound to the posterior part of his gluteal region. Following resuscitation, he is found to have great difficulty rising to a standing position from the seated position. Which of the following muscles was most likely affected by this injury:

a) Quadriceps femoris
b) Iliopsoas
c) Hamstrings
d) **Gluteus maximus** ✔
e) Gluteus medius

Answer

The gluteus maximus is responsible for extension and lateral rotation at the hip and is the prime muscle that extends the flexed hip, and is used to rise from a seated position. It is innervated by the inferior gluteal nerve which may have been injured in this case.

Notes

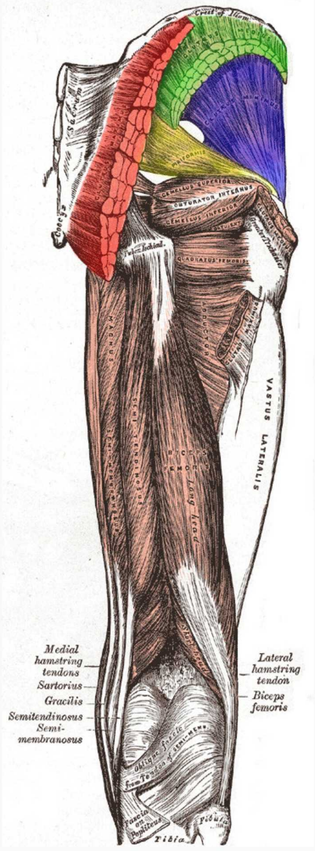
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 9 of 106

A 43 year old window cleaner is brought to the ED after falling from a 5 metre platform. Imaging has shown multiple vertebral fractures and you are concerned about possible neurological injuries. The obturator nerve receives nerve fibres from which of the following nerve roots:

a L1, L2

b L1 – L4

c L1 – L3

d L2 – L4

e L3, L4

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Anatomy: Hip and Thigh

Question 9 of 106

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a) L1, L2
b) L1 – L4
c) L1 – L3
d) **L2 – L4** ✔
e) L3, L4

Answer

The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Notes

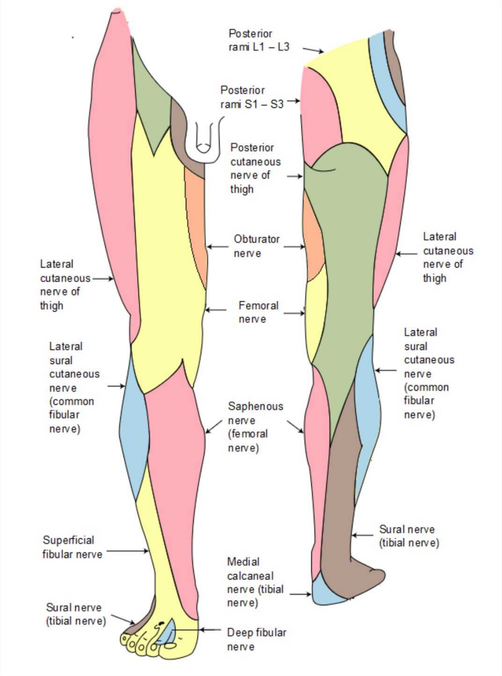
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 10 of 106

An unknown male is brought into the department after being struck by a lorry whilst crossing the road. Imaging shows extensive injuries in the pelvic region including trauma to the gluteus maximus. The gluteus maximus muscle primarily acts to produce which of the following movements:

a Extension, medial rotation and abduction of the thigh

b Extension and medial rotation

c Extension, lateral rotation and abduction of the thigh

d Lateral rotation and adduction of the thigh

e Extension, medial rotation and adduction of the thigh

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Anatomy: Hip and Thigh

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a) Extension, medial rotation and abduction of the thigh
b) Extension and medial rotation
c) **Extension, lateral rotation and abduction of the thigh** ✔
d) Lateral rotation and adduction of the thigh
e) Extension, medial rotation and adduction of the thigh

Answer

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh.

Notes

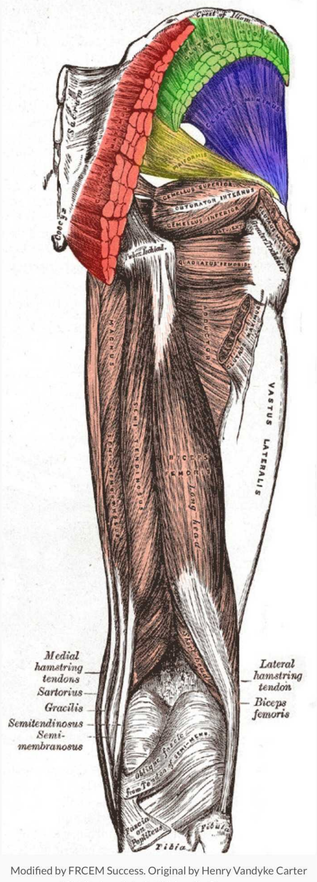
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
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Anatomy: Hip and Thigh



Question 11 of 106

An 18 year old man is brought into the ED after sustaining a deep wound to his left thigh after an accident on a building site. Imaging has shown trauma to the quadriceps femoris muscles. The quadriceps femoris muscles primarily act to produce which of the following movements:

a Extension of the thigh

b Extension of the leg

c Flexion of the thigh

d Flexion of the leg

e Extension of the thigh and extension of the leg

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Anatomy: Hip and Thigh



Question 11 of 106

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a) Extension of the thigh
b) Extension of the leg ✔
c) **Flexion of the thigh** ✖
d) Flexion of the leg
e) Extension of the thigh and extension of the leg

Answer

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

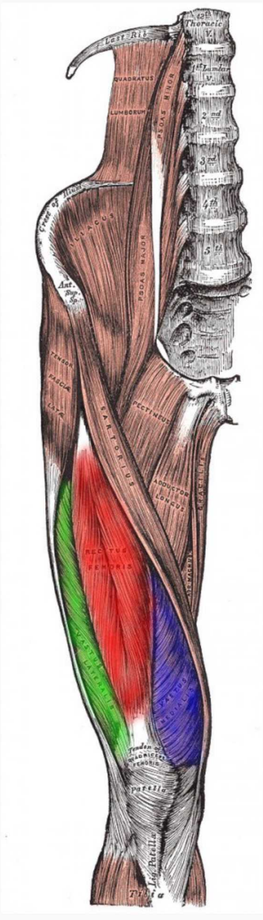
Notes

Muscle	Action(s)	Innervation
Rectus femoris (red)	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)
Vastus lateralis (green)	Extension at knee	Femoral nerve (L2 – L4)
Vastus medialis (blue)	Extension at knee	Femoral nerve (L2 – L4)
Vastus intermedius	Extension at knee	Femoral nerve (L2 – L4)

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. Because the vastus muscles insert into the margins of the patella as well as into the quadriceps femoris tendon, they stabilise the position of the patella during knee joint movement.

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4). A tap on the patella ligament tests reflex activity mainly at spinal cord levels L3/L4.



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Anatomy: Hip and Thigh



Question 12 of 106

You are giving a teaching session to a group of final year medical students regarding lower limb neurology. Which of the following clinical features would be expected in an obturator nerve palsy:

a Weakness of hip extension

b Weakness of hip abduction

c Weakness of hip adduction

d Loss of sensation over anterolateral thigh

e Weakness of hip flexion

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Anatomy: Hip and Thigh

Question 12 of 106

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a) Weakness of hip extension
b) Weakness of hip abduction
c) **Weakness of hip adduction** ✔
d) Loss of sensation over anterolateral thigh
e) Weakness of hip flexion

Answer

Damage to the obturator nerve results in weak adduction of the hip with lateral swinging of the lmb during walking due to unopposed abduction.

Notes

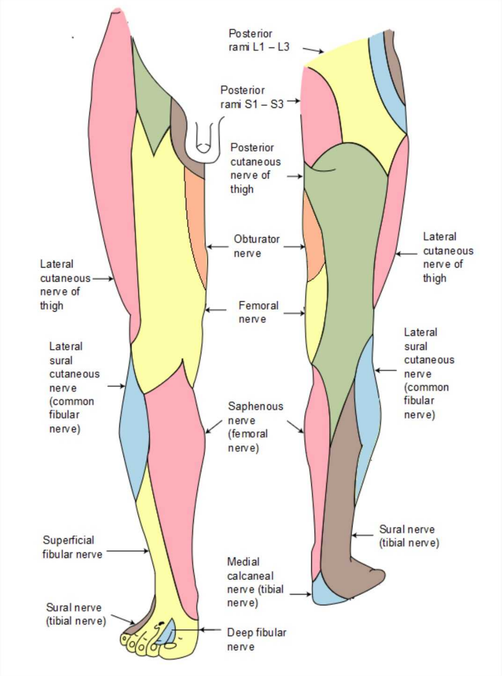
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 13 of 106

You have been asked to give a tutorial to a group of medical students about the vascular anatomy of the lower limb. The profunda femoris artery is a branch of which of the following arteries:

a Femoral artery

b Obturator artery

c External iliac artery

d Internal iliac artery

e Superior gluteal artery

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Question 13 of 106

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a) **Femoral artery** ✔
b) Obturator artery
c) External iliac artery
d) Internal iliac artery
e) Superior gluteal artery

Answer

The femoral artery gives rise to the deep profunda femoris artery in the femoral triangle which is a major source of blood supply to the medial and posterior compartments of the thigh and the proximal femur.

Notes

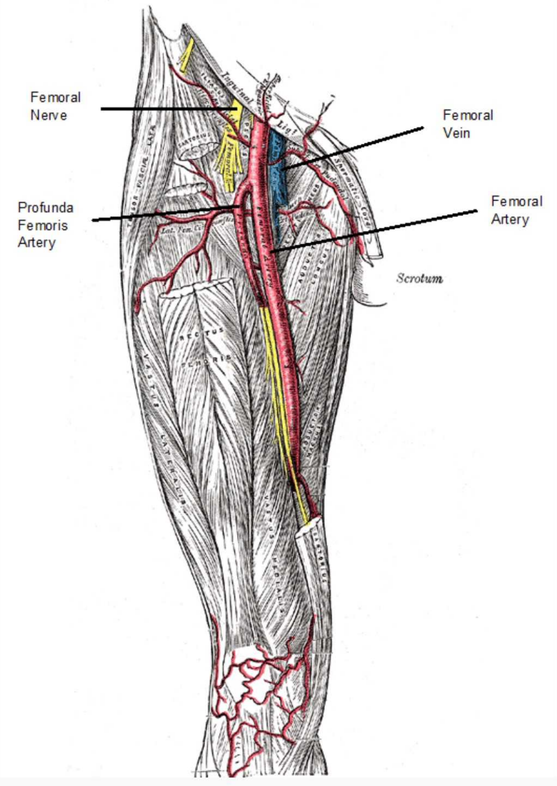
The major artery supplying the lower limb is the femoral artery. The femoral artery is the continuation of the external iliac artery, beginning as the vessel passes under the inguinal ligament to enter the femoral triangle in the anterior thigh.

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). The femoral vein lies immediately medial to this pulsation, which is an important landmark for central venous line insertion. Medial to the femoral vein is the femoral canal which contains lymphatics and lies immediately lateral to the pubic tubercle. The femoral nerve lies lateral to the femoral artery.

The femoral artery gives rise to the deep profunda femoris artery in the femoral triangle which is a major source of blood supply to the medial and posterior compartments of the thigh and the proximal femur.

After exiting the femoral triangle, the femoral artery continues down the anterior surface of the thigh via the adductor canal. During its descent it supplies the anterior thigh, giving rise to numerous superficial cutaneous branches.

The femoral artery becomes the popliteal artery after entering the posterior compartment of the thigh through the adductor hiatus just proximal to the knee.



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Anatomy: Hip and Thigh



Question 14 of 106

A 32 year old man presents to the ED after sustaining multiple stab wounds to the right thigh during an altercation in a pub. Imaging has shown trauma to the semimembranosus and semitendinosus muscles. These act together to primarily produce which of the following movements at the hip joint:

a Extension and abduction at hip

b Extension and adduction at hip

c Extension and medial rotation at hip

d Extension and lateral rotation at hip

e Flexion and adduction at hip

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Anatomy: Hip and Thigh

Question 14 of 106

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a) Extension and abduction at hip
b) Extension and adduction at hip
c) **Extension and medial rotation at hip** ✔
d) Extension and lateral rotation at hip
e) Flexion and adduction at hip

Answer

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

Notes

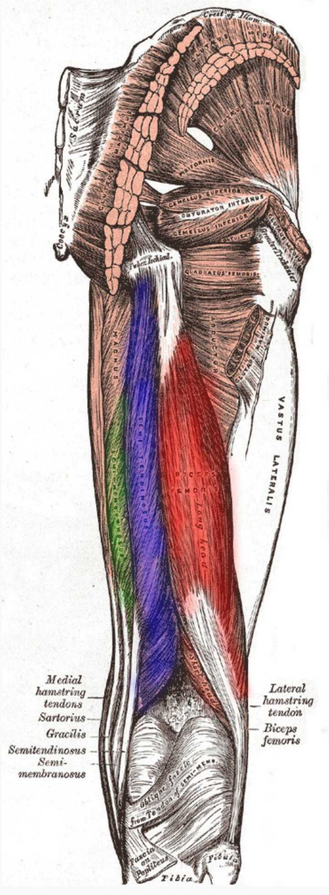
Muscle	Action(s)	Innervation
Biceps femoris (red)	Flexion at knee, extension and lateral rotation at hip	Sciatic nerve (L5 – S2)
Semitendinosus (blue)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)
Semimembranosus (green)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)

The hamstrings are composed of three individual muscles; the biceps femoris (red), the semitendinosus (blue) and the semimembranosus (green).

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

The hamstring muscles are all innervated by the tibial division of the sciatic nerve (L5 – S2), except for the short head of the biceps femoris innervated by the common fibular division.

To test the hamstrings the patient flexes their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.



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Anatomy: Hip and Thigh



Question 15 of 106

A 34 year old man presents to the ED following a 3 day history of fever. On examination you note tender lymphadenopathy at the superficial inguinal lymph nodes. Which of the following best describes the location of the superficial inguinal lymph nodes:

a Medial to the femoral vein in the femoral canal

b In a line superior to the inguinal ligament

c In a line inferior to the inguinal ligament

d Lateral to the femoral vein in the femoral canal

e Following the course of the external iliac vein

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Anatomy: Hip and Thigh



Question 15 of 106

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a) **Medial to the femoral vein in the femoral canal** ✗
b) In a line superior to the inguinal ligament
c) In a line inferior to the inguinal ligament ✓
d) Lateral to the femoral vein in the femoral canal
e) Following the course of the external iliac vein

Answer

The superficial inguinal lymph nodes (about 10 in number) are located in the superficial fascia, forming a line below the inguinal ligament, and medially extending inferiorly along the terminal part of the great saphenous vein.

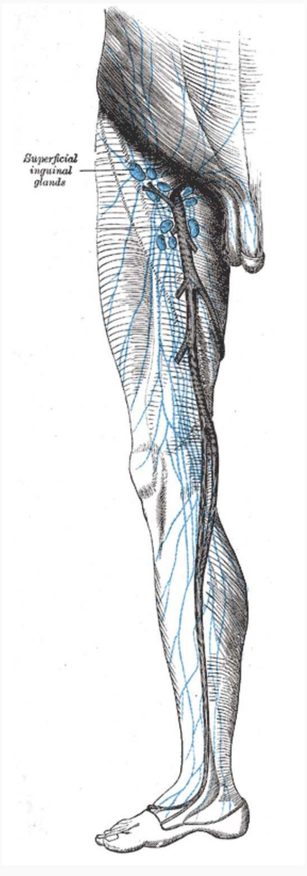
Notes

The inguinal nodes are found in the upper aspect of the femoral triangle.

The superficial inguinal lymph nodes (about 10 in number) are located in the superficial fascia, forming a line below the inguinal ligament, and medially extending inferiorly along the terminal part of the great saphenous vein. They receive lymph from the gluteal region, lower abdominal wall, perineum and superficial regions of the lower limb.

The deep inguinal lymph nodes (about 1 – 3 in number) lie medial to the femoral vein within the femoral canal. They receive lymph from deep lymphatics associated with the femoral vessels and from the glans penis or clitoris in the perineum.

The inguinal lymph nodes drain to the external iliac lymph nodes associated with the external iliac artery in the abdomen.



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Anatomy: Hip and Thigh



Question 16 of 106

A 23 year old horse rider is brought to the ED following a fall during a show jumping competition. She complains of pain in her lumbar spine. On examination you note loss of sensation in the S5 dermatome. The S5 dermatome is best tested at which of the following landmarks:

a Ischial tuberosity

b Posterior superior iliac spine

c Greater trochanter of the femur

d Gluteal fold

e Perianal area

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a) Ischial tuberosity
b) Posterior superior iliac spine
c) Greater trochanter of the femur
d) Gluteal fold
e) **Perianal area** ✔

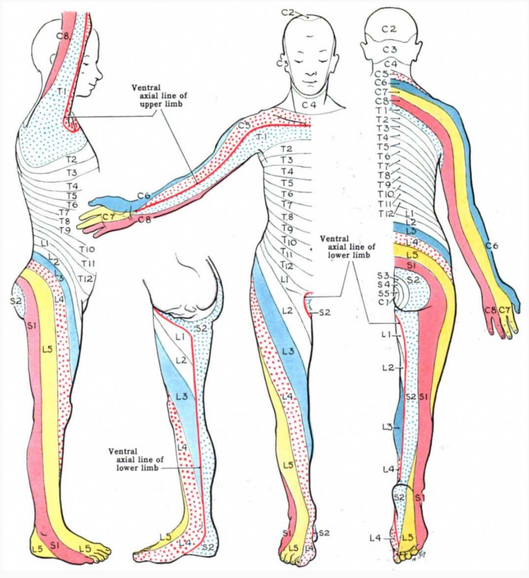
Answer

The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.

Notes

Dermatome	Landmark
L1	Upper Anterior Thigh
L2	Mid Anterior Thigh
L3	Medial Femoral Condyle
L4	Medial Malleolus
L5	Dorsum 3rd MTP Joint
S1	Lateral Heel
S2	Popliteal Fossa
S3	Ischial Tuberosity
S5	Perianal Area

- The T12 dermatome is best tested at the midclavicular line, over the midpoint of the inguinal ligament.
- The L1 dermatome is best tested on the upper anterior thigh, at a point midway between the key sensory points for T12 and L2.
- The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.
- The L3 dermatome is best tested at the medial femoral condyle above the knee.
- The L4 dermatome is best tested over the medial malleolus.
- The L5 dermatome is best tested on the dorsum of the foot at the third metatarsophalangeal joint.
- The S1 dermatome is best tested on the lateral aspect of the calcaneus.
- The S2 dermatome is best tested at the midpoint of the popliteal fossa.
- The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).
- The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.



By Grant, John Charles Boileau (An atlas of anatomy, / by regions 1962) [Public domain], via Wikimedia Commons

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Anatomy: Hip and Thigh



Question 17 of 106

A 45 year old woman presents to the ED with a painful swelling in her right groin. She is known to use intravenous drugs and last injected a few hours ago. Imaging has shown a femoral artery pseudoaneurysm within the femoral sheath. The femoral sheath originates from which of the following structures:

a Femoral canal

b Extraperitoneal fascia

c Inguinal ligament

d External oblique fascia

e Internal oblique fascia

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Anatomy: Hip and Thigh

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a) Femoral canal
b) **Extraperitoneal fascia** ✔
c) Inguinal ligament
d) External oblique fascia
e) Internal oblique fascia

Answer

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal).

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

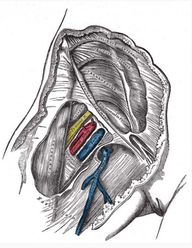
Contents

The femoral triangle contains (from lateral to medial):

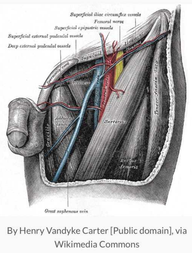
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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By Henry Vandyke Carter [Public domain], via Wikimedia Commons

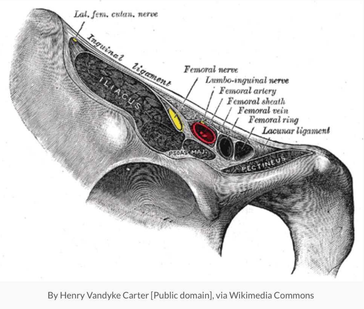
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 18 of 106

You are examining the lower limbs of a 54 year old man who presented after falling from a ladder at home. During your neurological assessment you note a weakness of hip extension. Extension of the thigh at the hip joint is primarily produced by which of the following muscles:

a Quadriceps femoris and gluteus maximus

b Gluteus maximus and gluteus medius

c Hamstrings and gluteus maximus

d Quadriceps femoris, gluteus medius and gluteus minimus

e Hamstrings, gluteus medius and gluteus minimus

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Anatomy: Hip and Thigh

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a) Quadriceps femoris and gluteus maximus
b) Gluteus maximus and gluteus medius
c) **Hamstrings and gluteus maximus** ✔
d) Quadriceps femoris, gluteus medius and gluteus minimus
e) Hamstrings, gluteus medius and gluteus minimus

Answer

Extension of the thigh at the hip joint is primarily produced by the hamstring muscles and the gluteus maximus, innervated by the sciatic nerve and the inferior gluteal nerve respectively.

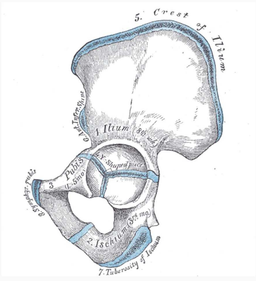
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

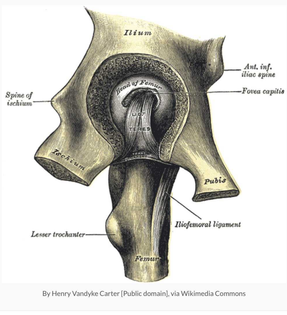


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

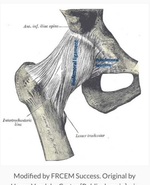
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



By Henry Vandyke Carter [Public domain], via Wikimedia Commons

There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 19 of 106

A 76 year old woman presents with left flank pain and fever. A CT scan has shown a psoas abscess. The psoas major muscle acts primarily to produce which of the following movements:

a Flexion and lateral rotation of the thigh

b Flexion of the thigh and flexion of the leg

c Flexion and abduction of the thigh

d Flexion and adduction of the thigh

e Flexion of the thigh and extension of the leg

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Anatomy: Hip and Thigh

Question 19 of 106

A 76 year old woman presents with left flank pain and fever. A CT scan has shown a psoas abscess. The psoas major muscle acts primarily to produce which of the following movements:

a) Flexion and lateral rotation of the thigh ✔
b) Flexion of the thigh and flexion of the leg
c) Flexion and abduction of the thigh
d) Flexion and adduction of the thigh
e) Flexion of the thigh and extension of the leg

Answer

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint.

Notes

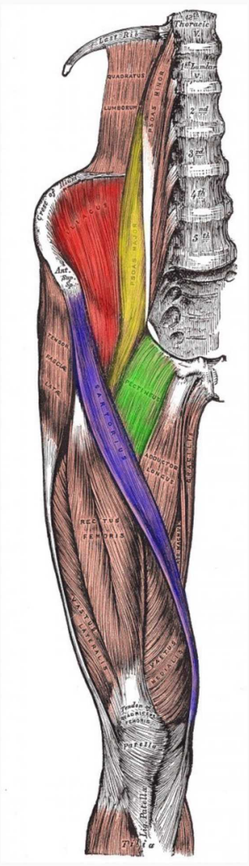
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 20 of 106

You are examining the lower limbs of a 54 year old man who presented after falling from a ladder at home. During your neurological assessment you note a weakness of hip extension. Which of the following nerves are most important for extension of the thigh at the hip joint:

a Superior and inferior gluteal nerves

b Superior gluteal and sciatic nerve

c Inferior gluteal and sciatic nerve

d Sciatic and femoral nerve

e Sciatic and obturator nerve

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Anatomy: Hip and Thigh

Question 20 of 106

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a) Superior and inferior gluteal nerves
b) Superior gluteal and sciatic nerve
c) **Inferior gluteal and sciatic nerve** ✔
d) Sciatic and femoral nerve
e) Sciatic and obturator nerve

Answer

Extension of the thigh at the hip joint is primarily produced by the hamstring muscles, and the gluteus maximus, innervated by the sciatic nerve and the inferior gluteal nerve respectively.

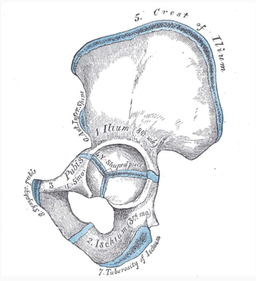
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
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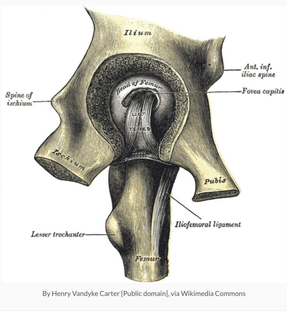


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Ligaments

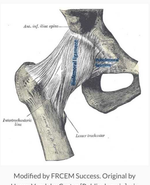
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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
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- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

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Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 21 of 106

You are discussing approaches to analgesia in a patient with a fractured neck of femur. Your consultant suggests a femoral nerve block. The femoral triangle is bordered laterally by which of the following structures:

a Femoral canal

b Sartorius muscle

c Iliacus muscle

d Rectus femoris muscle

e Tensor fascia lata muscle

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Anatomy: Hip and Thigh

Question 21 of 106

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a) Femoral canal
b) **Sartorius muscle** ✔
c) Iliacus muscle
d) Rectus femoris muscle
e) Tensor fascia lata muscle

Answer

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

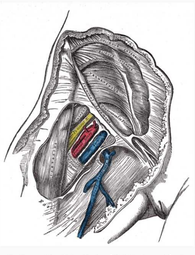
Contents

The femoral triangle contains (from lateral to medial):

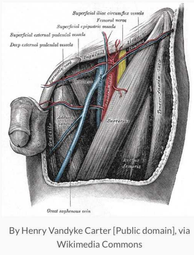
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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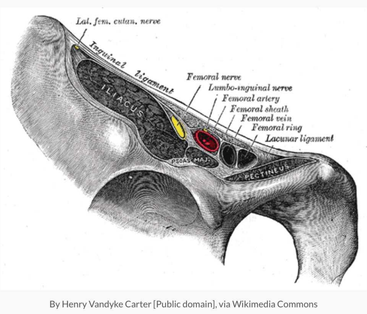
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 22 of 106

A 53 year old man presents to the ED after falling from a horse onto a fence. Imaging has shown trauma to the contents of the left femoral sheath. Which of the following structures is NOT found in the femoral sheath:

a Femoral artery

b Femoral vein

c Femoral nerve

d Deep inguinal lymph nodes

e Femoral canal

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Anatomy: Hip and Thigh

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b) Femoral vein
c) **Femoral nerve** ✔
d) Deep inguinal lymph nodes
e) Femoral canal

Answer

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

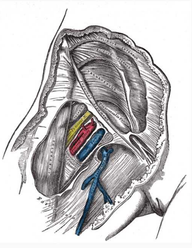
Contents

The femoral triangle contains (from lateral to medial):

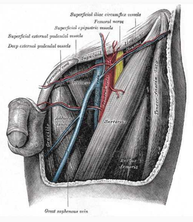
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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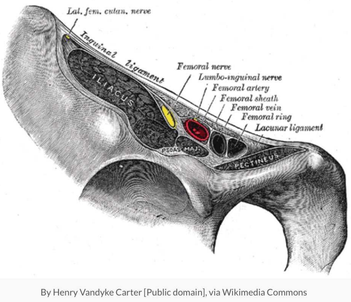
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Anatomy: Hip and Thigh



Question 23 of 106

You have been asked to teach a group of medical students about neurological examination of the lower limbs. The L3 dermatome is best tested at which of the following landmarks:

a Just inferior to the midpoint of the inguinal ligament

b At the medial malleolus

c At the medial femoral condyle

d At the lateral femoral condyle

e At the midpoint of the popliteal fossa

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Anatomy: Hip and Thigh

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c) **At the medial femoral condyle** ✔
d) At the lateral femoral condyle
e) At the midpoint of the popliteal fossa

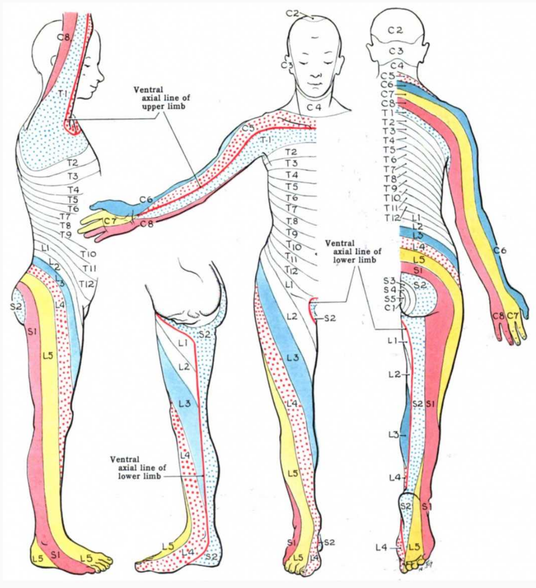
Answer

The L3 dermatome is best tested at the medial femoral condyle above the knee.

Notes

Dermatome	Landmark
L1	Upper Anterior Thigh
L2	Mid Anterior Thigh
L3	Medial Femoral Condyle
L4	Medial Malleolus
L5	Dorsum 3rd MTP Joint
S1	Lateral Heel
S2	Popliteal Fossa
S3	Ischial Tuberosity
S5	Perianal Area

- The T12 dermatome is best tested at the midclavicular line, over the midpoint of the inguinal ligament.
- The L1 dermatome is best tested on the upper anterior thigh, at a point midway between the key sensory points for T12 and L2.
- The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.
- The L3 dermatome is best tested at the medial femoral condyle above the knee.
- The L4 dermatome is best tested over the medial malleolus.
- The L5 dermatome is best tested on the dorsum of the foot at the third metatarsophalangeal joint.
- The S1 dermatome is best tested on the lateral aspect of the calcaneus.
- The S2 dermatome is best tested at the midpoint of the popliteal fossa.
- The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).
- The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.



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Anatomy: Hip and Thigh



Question 24 of 106

A 21 year old man presents to the ED after sustaining multiple deep lacerations to the posterior thigh during a fight. You suspect an injury to the hamstring muscles. The hamstring muscles primarily act together to produce which of the following movements:

a Flexion of the thigh and flexion of the leg

b Flexion of the thigh and extension of the leg

c Extension of the thigh and flexion of the leg

d Extension of the thigh and extension of the leg

e Extension and adduction of the thigh

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Anatomy: Hip and Thigh

Question 24 of 106

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a) **Flexion of the thigh and flexion of the leg** ✗
b) Flexion of the thigh and extension of the leg
c) Extension of the thigh and flexion of the leg ✓
d) Extension of the thigh and extension of the leg
e) Extension and adduction of the thigh

Answer

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint.

Notes

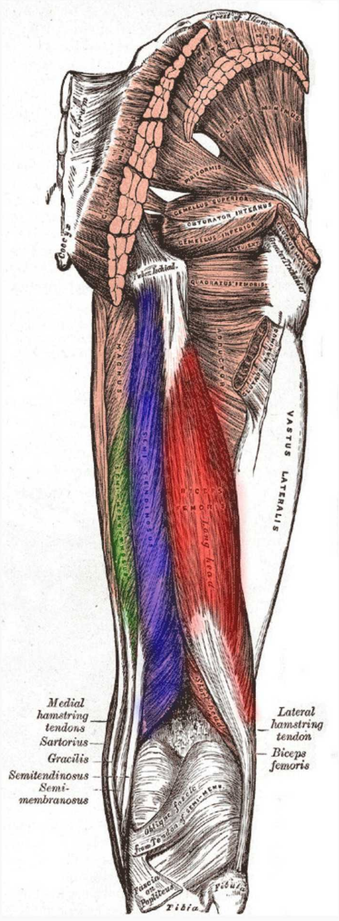
Muscle	Action(s)	Innervation
Biceps femoris (red)	Flexion at knee, extension and lateral rotation at hip	Sciatic nerve (L5 – S2)
Semitendinosus (blue)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)
Semimembranosus (green)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)

The hamstrings are composed of three individual muscles; the biceps femoris (red), the semitendinosus (blue) and the semimembranosus (green).

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

The hamstring muscles are all innervated by the tibial division of the sciatic nerve (L5 – S2), except for the short head of the biceps femoris innervated by the common fibular division.

To test the hamstrings the patient flexes their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.



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Anatomy: Hip and Thigh



Question 25 of 106

A 76 year old woman present to the ED after feeling in a "pop" in her right hip. She recently underwent a right total hip replacement, you suspect the hip is now dislocated. Regarding the hip joint, which of the following statements is INCORRECT:

a The acetabulum is formed by the fusion of two bones, the ischium and pubis.

b The transverse acetabular ligament is an extension of the acetabular labrum.

c The ligament of the head of the femur extends from the fovea of the head of femur to the acetabular fossa.

d The ligament of the head of the femur carries a small branch of the obturator artery.

e The hip joint is a synovial ball and socket joint.

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Anatomy: Hip and Thigh

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b) The transverse acetabular ligament is an extension of the acetabular labrum.
c)
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d) The ligament of the head of the femur carries a small branch of the obturator artery.
e) The hip joint is a synovial ball and socket joint.

Answer

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis. The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves. The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.

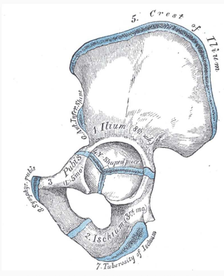
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

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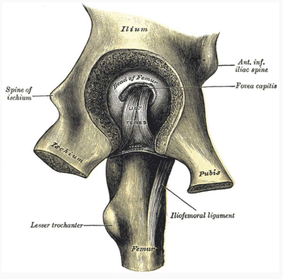


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

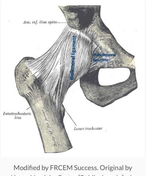
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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 26 of 106

A 79 year old woman presents to the ED after falling. She complains of pain in the right groin and you note her right leg is shortened and externally rotated. You suspect a right hip fracture and plan to administer a nerve block. Which of the following nerves is NOT an important nerve involved in innervation of the hip joint:

a Femoral nerve

b Obturator nerve

c Superior gluteal nerve

d Inferior gluteal nerve

e Nerve to quadratus femoris

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d) Inferior gluteal nerve ✔
e) **Nerve to quadratus femoris** ✘

Answer

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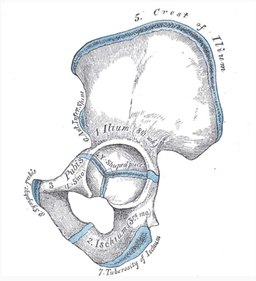
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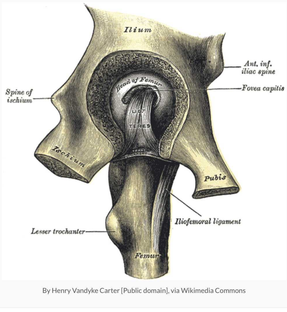


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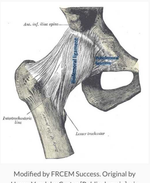
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Anatomy: Hip and Thigh



Question 27 of 106

You are assessing a 76 year old woman who presents with weakness to the left hip following a fall. She is pain free. On examination she has marked weakness of flexion and lateral rotation of the hip. You are aware that the iliacus performs these action. The iliacus muscle is innervated by which of the following nerves:

a Femoral nerve

b Obturator nerve

c Sciatic nerve

d Pudendal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 27 of 106

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a) **Femoral nerve** ✔
b) Obturator nerve
c) Sciatic nerve
d) Pudendal nerve
e) Inferior gluteal nerve

Answer

The iliacus is innervated by the femoral nerve (L2, L3).

Notes

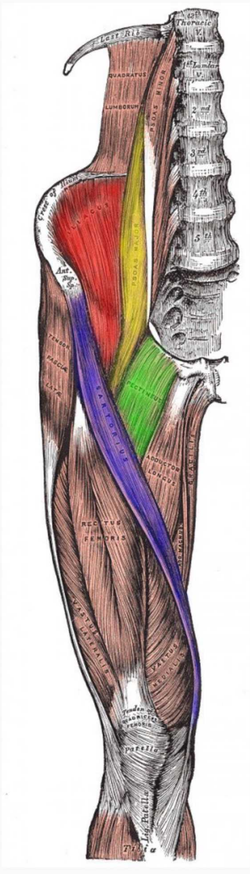
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 28 of 106

You form part of the trauma team caring for a motorcyclist who was involved in a collision with a van. You receive a phone call from the on-call radiologist informing you that the patient has an injury to the nerve supplying the hamstring muscles. The hamstring muscles are innervated by which of the following nerves:

a Femoral nerve

b Obturator nerve

c Sciatic nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 28 of 106

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a) Femoral nerve
b) Obturator nerve
c) **Sciatic nerve** ✔
d) Superior gluteal nerve
e) Inferior gluteal nerve

Answer

The hamstring muscles are all innervated by the sciatic nerve (L5 – S2).

Notes

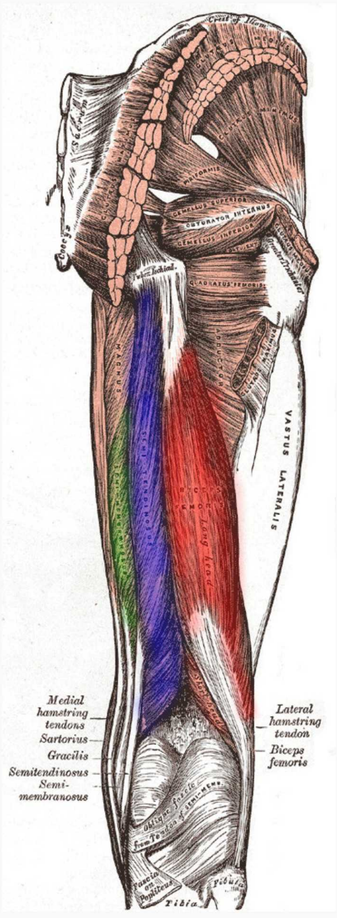
Muscle	Action(s)	Innervation
Biceps femoris (red)	Flexion at knee, extension and lateral rotation at hip	Sciatic nerve (L5 – S2)
Semitendinosus (blue)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)
Semimembranosus (green)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)

The hamstrings are composed of three individual muscles; the biceps femoris (red), the semitendinosus (blue) and the semimembranosus (green).

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

The hamstring muscles are all innervated by the tibial division of the sciatic nerve (L5 – S2), except for the short head of the biceps femoris innervated by the common fibular division.

To test the hamstrings the patient flexes their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.



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Anatomy: Hip and Thigh



Question 29 of 106

A 75 year old lady slips on a wet bathroom floor and presents to ED with her left leg shortened and externally rotated. Imaging demonstrates an intracapsular fracture of the neck of femur. The patient is at risk of avascular necrosis of the femoral head. This is most likely to occur due to lack of blood supply from which of the following arteries:

a Medial circumflex artery

b Obturator artery

c Superior gluteal artery

d Inferior gluteal artery

e Lateral circumflex artery

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Anatomy: Hip and Thigh

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a) Medial circumflex artery ✔
b) **Obturator artery** ✘
c) Superior gluteal artery
d) Inferior gluteal artery
e) Lateral circumflex artery

Answer

In adults, the primary blood supply to the head of the femur is from branches of the medial femoral circumflex artery. The lateral circumflex artery anastomoses with the medial femoral circumflex artery and assists in supplying the femoral head. The obturator artery gives rise to the artery of the head of femur which runs in the ligamentum teres and is usually insufficient to supply the head of femur in adults (but is an important source of blood supply in children up to about 8 years). The superior and inferior gluteal arteries supply the hip joint but not typically the head of femur.

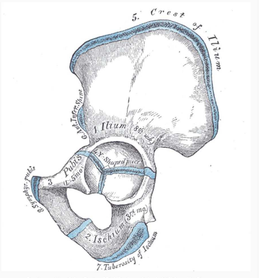
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

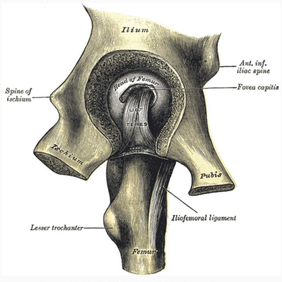


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

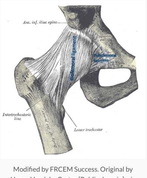
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 30 of 106

A 32 year old woman is brought to the ED after falling from a horse. Imaging shows multiple injuries to the pelvic region including transection of the nerve that supplies the piriformis muscle. The piriformis muscle acts primarily to produce which of the following movements:

a Abduction and lateral rotation of the thigh

b Abduction and medial rotation of the thigh

c Adduction and lateral rotation of the thigh

d Adduction and medial rotation of the thigh

e Abduction and flexion of the thigh

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a) Abduction and lateral rotation of the thigh ✔
b) Abduction and medial rotation of the thigh
c) Adduction and lateral rotation of the thigh
d) Adduction and medial rotation of the thigh
e) Abduction and flexion of the thigh

Answer

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint.

Notes

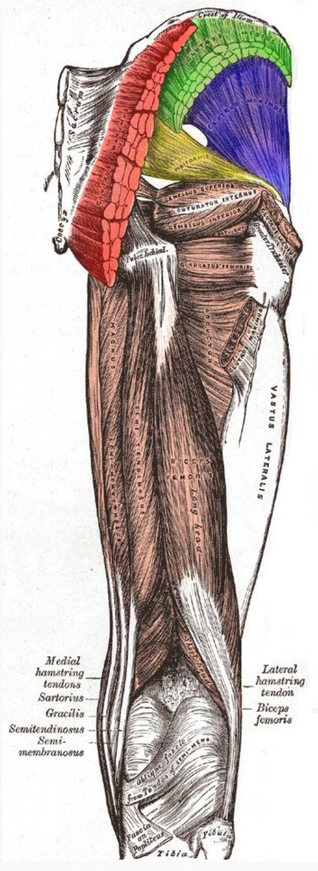
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 31 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered anteriorly by which of the following structures:

a Sartorius muscle

b Inguinal ligament

c Fascia lata

d Femoral sheath

e Femoral artery

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a) Sartorius muscle
b) **Inguinal ligament** ✔
c) Fascia lata
d) Femoral sheath
e) Femoral artery

Answer

The femoral ring is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

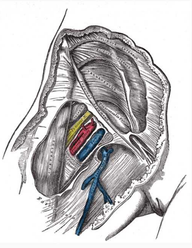
Contents

The femoral triangle contains (from lateral to medial):

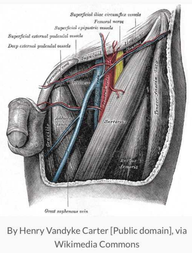
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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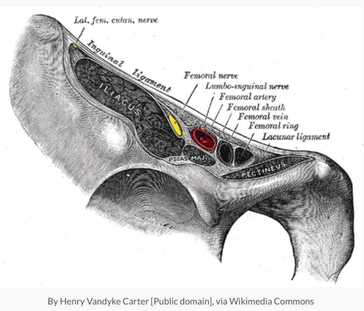
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 32 of 106

A 65 year old woman presents to the ED with a tender left leg. She has been assessed by your Consultant colleague who feels she may have thrombophlebitis of the great saphenous vein. Which of the following best describes the course of the great saphenous vein:

a Passes anterior to medial malleolus and ascends medial side of leg, knee and thigh

b Passes posterior to medial malleolus and ascends medial side of leg, knee and thigh

c Passes anterior to lateral malleolus and ascends lateral side of leg, knee and thigh

d Passes posterior to lateral malleolus and ascends lateral side of leg, knee and thigh

e Passes posterior to lateral malleolus and ascends posterior leg, knee and thigh

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Anatomy: Hip and Thigh

Question 32 of 106

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a) ✔
Passes anterior to medial malleolus and ascends medial side of leg, knee and thigh
b) Passes posterior to medial malleolus and ascends medial side of leg, knee and thigh
c) Passes anterior to lateral malleolus and ascends lateral side of leg, knee and thigh
d) Passes posterior to lateral malleolus and ascends lateral side of leg, knee and thigh
e) Passes posterior to lateral malleolus and ascends posterior leg, knee and thigh

Answer

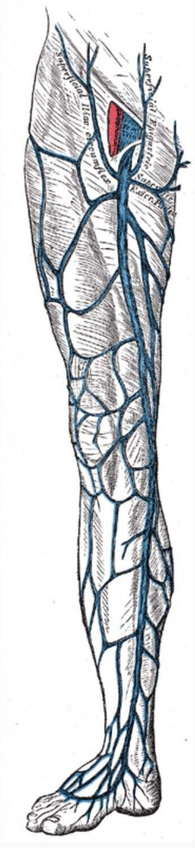
The great saphenous vein passes anterior to the medial malleolus, travels up the medial side of the leg, knee and thigh to pass through the saphenous opening in the deep fascia covering the femoral triangle, and join with the femoral vein just below the inguinal ligament.

Notes

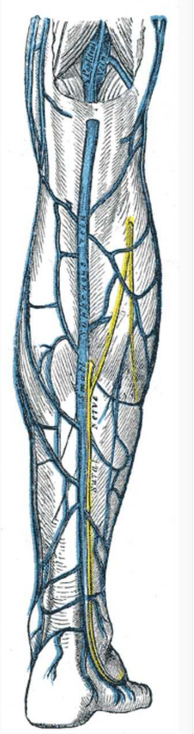
The great and small saphenous veins originate from the medial and lateral sides respectively of the dorsal venous arch in the foot.

The great saphenous vein passes anterior to the medial malleolus, travels up the medial side of the leg, knee and thigh to pass through the saphenous opening in the deep fascia covering the femoral triangle and join with the femoral vein just below the inguinal ligament.

The small saphenous vein passes posterior to the lateral malleolus and up the back of the leg to pierce the deep fascia and join the popliteal vein in the popliteal fossa posterior to the knee.



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Anatomy: Hip and Thigh



Question 33 of 106

A 24 year old athlete presents to ED complaining of pain in his hip with a limp. He reports that he was performing the 100m sprint when he heard a pop. On examination he has weakness of hip flexion and lateral rotation. Imaging shows avulsion of the anterior superior iliac spine. Which of the following muscles is most likely affected:

a Rectus femoris

b Sartorius

c Gracilis

d Psoas major

e Iliacus

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Anatomy: Hip and Thigh

Question 33 of 106

A 24 year old athlete presents to ED complaining of pain in his hip with a limp. He reports that he was performing the 100m sprint when he heard a pop. On examination he has weakness of hip flexion and lateral rotation. Imaging shows avulsion of the anterior superior iliac spine. Which of the following muscles is most likely affected:

a) Rectus femoris
b) **Sartorius** ✔
c) Gracilis
d) Psoas major
e) Iliacus

Answer

The sartorius muscle originates from the anterior superior iliac spine and acts to assist with hip flexion, abduction and lateral rotation of the hip, and flexion of the knee. Turning the foot to look at the sole demonstrates all four actions of the sartorius.

Notes

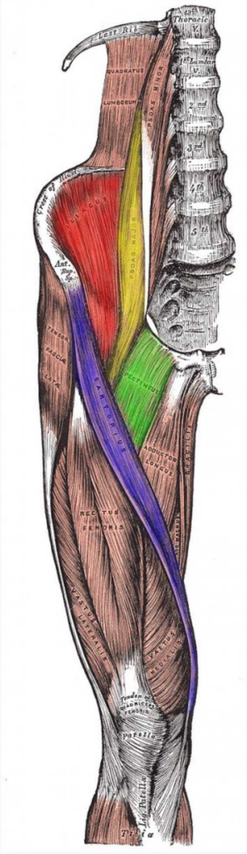
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 34 of 106

A 43 year old window cleaner is brought to the ED after falling from a 5 metre platform. Imaging has shown multiple vertebral fractures and an injury to the obturator nerve. Which of the following best describes the cutaneous innervation of the obturator nerve:

a Skin over anterior thigh

b Skin over anterolateral thigh

c Skin over posterior thigh

d Skin over upper medial thigh

e Skin over medial thigh and medial leg

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Question 34 of 106

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a) Skin over anterior thigh
b) Skin over anterolateral thigh
c) Skin over posterior thigh
d) **Skin over upper medial thigh** ✔
e) Skin over medial thigh and medial leg

Answer

The obturator nerve supplies skin over the medial upper thigh.

Notes

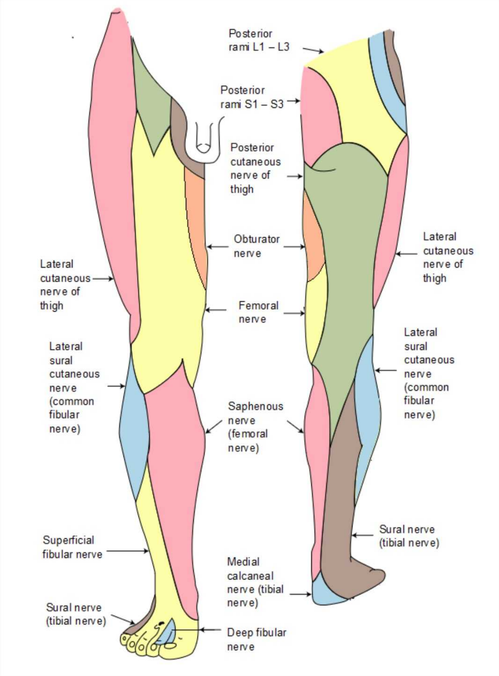
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 35 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered posteriorly by which of the following structures:

a Inguinal ligament

b Lacunar ligament

c Pectineal ligament

d Iliolumbar ligament

e Femoral canal

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Question 35 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered posteriorly by which of the following structures:

a) Inguinal ligament
b) Lacunar ligament
c) **Pectineal ligament** ✔
d) Iliolumbar ligament
e) Femoral canal

Answer

The femoral ring is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

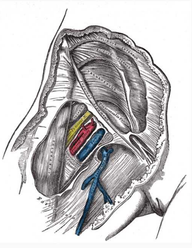
Contents

The femoral triangle contains (from lateral to medial):

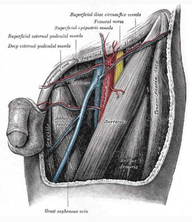
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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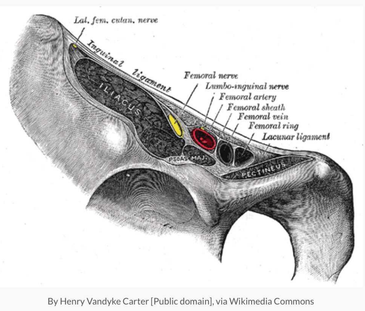
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 36 of 106

An 83 year old woman is brought to ED falling a fall in which she has sustained posterior dislocation and fracture of the neck of femur. A tear of the ligament of the head of femur may result in damage to a branch of which of the following arteries:

a Femoral artery

b Profunda femoris artery

c Superior gluteal artery

d Obturator artery

e Medial circumflex artery

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a) Femoral artery
b) Profunda femoris artery
c) Superior gluteal artery
d) **Obturator artery** ✔
e) Medial circumflex artery

Answer

The obturator artery gives rise to an acetabular branch that runs in the round ligament of the head of the femur.

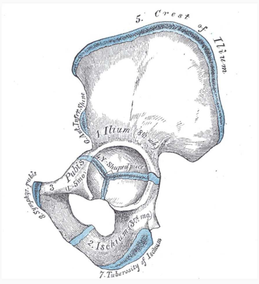
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

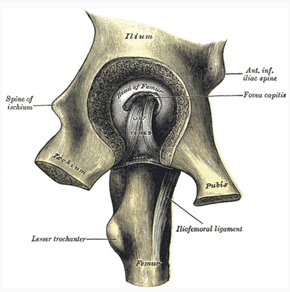


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

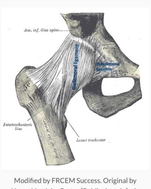
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 37 of 106

A 31 year old man is brought to ED having been thrown off his motorbike. Following initial resuscitation and ruling out life-threatening injuries, you establish the patient has weakness of hip flexion. Which of the following nerves has most likely been injured:

a Obturator nerve

b Femoral nerve

c Sciatic nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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a) Obturator nerve
b) **Femoral nerve** ✔
c) Sciatic nerve
d) Superior gluteal nerve
e) Inferior gluteal nerve

Answer

Flexion of the hip is produced by the iliacus, the psoas major, the sartorius, rectus femoris and the pectineus muscles. The femoral nerve innervates the iliacus, pectineus, sartorius and quadriceps femoris muscles, and supplies skin on the anterior thigh, anteromedial knee and medial leg.

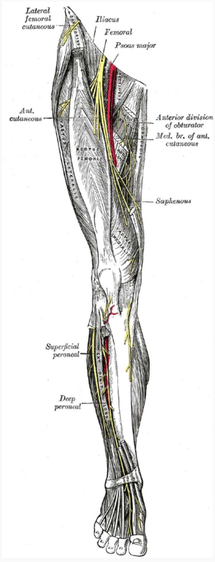
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

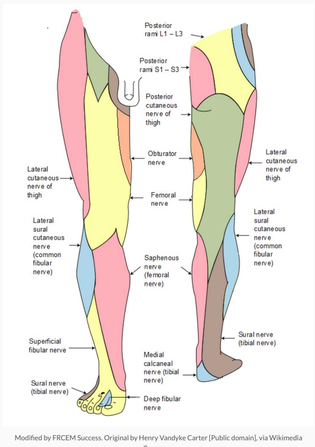
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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A 45 year old man is brought to the ED after sustaining a knife wound to the left groin in a fight. Your consultant is concerned about trauma in the region of the femoral triangle. Which of the following structures is NOT found in the femoral triangle:

a Femoral nerve

b Femoral vein

c Femoral artery

d Femoral canal

e Lateral femoral cutaneous nerve

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a) Femoral nerve
b) Femoral vein
c) Femoral artery
d) Femoral canal
e) **Lateral femoral cutaneous nerve** ✔

Answer

The femoral triangle contains (from lateral to medial) the femoral nerve, femoral artery, femoral vein and femoral canal. The lateral femoral cutaneous nerve is a nerve of the lumbar plexus that supplies skin on the lateral thigh.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

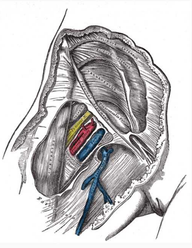
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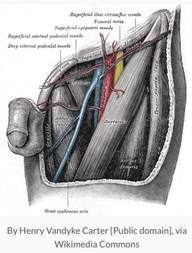
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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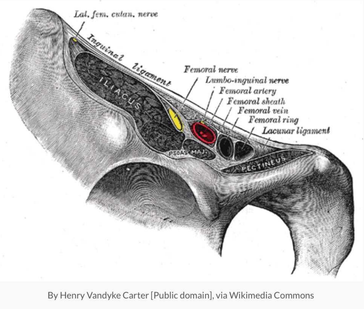
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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A 49 year old overweight female presents to ED complaining of a lump in her groin. You examine the patient and diagnose a femoral hernia. Which of the following structures would be found immediately lateral to the hernia:

a Femoral artery

b Femoral nerve

c Femoral vein

d Superficial epigastric vein

e Ilioinguinal nerve

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Anatomy: Hip and Thigh

Question 39 of 106

A 49 year old overweight female presents to ED complaining of a lump in her groin. You examine the patient and diagnose a femoral hernia. Which of the following structures would be found immediately lateral to the hernia:

a) Femoral artery
b) Femoral nerve
c) **Femoral vein** ✔
d) Superficial epigastric vein
e) Ilioinguinal nerve

Answer

The femoral vein will be immediately lateral. Femoral hernias result from the herniation of abdominal structures through the femoral ring, the proximal opening of the femoral canal, which is bordered medially by the lacunar ligament and laterally by the femoral vein. Femoral hernias, more common in women, typically present as a lump inferolaterally to the pubic tubercle, and are more prone to strangulation than inguinal hernias.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

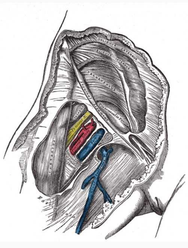
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The femoral triangle contains (from lateral to medial):

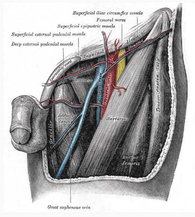
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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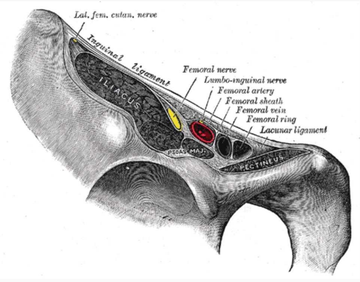
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 40 of 106

A 27 year old woman has sustained an injury to her quadriceps femoris muscle group after falling through a glass door. Which of the following muscles would you not expect to be affected:

a Biceps femoris

b Rectus femoris

c Vastus medialis

d Vastus intermedius

e Vastus lateralis

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Anatomy: Hip and Thigh

Question 40 of 106

A 27 year old woman has sustained an injury to her quadriceps femoris muscle group after falling through a glass door. Which of the following muscles would you not expect to be affected:

a) **Biceps femoris** ✔
b) Rectus femoris
c) Vastus medialis
d) Vastus intermedius
e) Vastus lateralis

Answer

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. The biceps femoris muscle is a hamstring muscle in the posterior thigh.

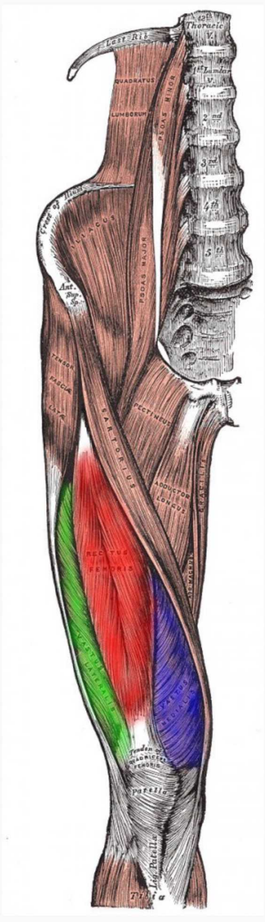
Notes

Muscle	Action(s)	Innervation
Rectus femoris (red)	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)
Vastus lateralis (green)	Extension at knee	Femoral nerve (L2 – L4)
Vastus medialis (blue)	Extension at knee	Femoral nerve (L2 – L4)
Vastus intermedius	Extension at knee	Femoral nerve (L2 – L4)

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. Because the vastus muscles insert into the margins of the patella as well as into the quadriceps femoris tendon, they stabilise the position of the patella during knee joint movement.

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4). A tap on the patella ligament tests reflex activity mainly at spinal cord levels L3/L4.



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Anatomy: Hip and Thigh



Question 41 of 106

A 74 year old woman presents to the ED complaining of a painful swelling in her left groin. She has been examined by your consultant who suspects a femoral hernia. Which of the following best describes the location of the femoral canal:

a Not contained within the femoral sheath, lateral to the femoral nerve

b Within the femoral sheath, medial to the femoral vein

c Lateral to the femoral vein, medial to the femoral artery

d Medial to the femoral vein, not contained within the femoral sheath

e Lateral to the femoral artery and vein

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Anatomy: Hip and Thigh

Question 41 of 106

A 74 year old woman presents to the ED complaining of a painful swelling in her left groin. She has been examined by your consultant who suspects a femoral hernia. Which of the following best describes the location of the femoral canal:

a) Not contained within the femoral sheath, lateral to the femoral nerve
b) Within the femoral sheath, medial to the femoral vein ✔
c) Lateral to the femoral vein, medial to the femoral artery
d) **Medial to the femoral vein, not contained within the femoral sheath** ✖
e) Lateral to the femoral artery and vein

Answer

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein, within the femoral sheath.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

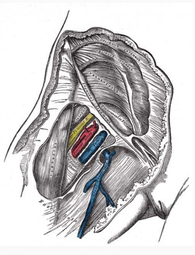
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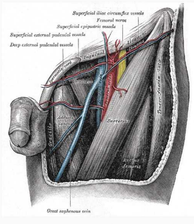
- The femoral nerve
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- The femoral vein
- The femoral canal

Femoral sheath

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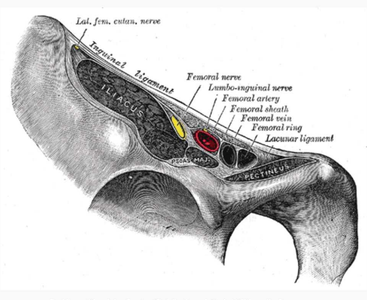
Femoral canal

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Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 42 of 106

A 45 year old man sustains a gunshot wound to the gluteal region. During rehabilitation he complains of weakness abducting and medially rotating his thigh. Which of the following muscles has most likely been damaged:

a Piriformis

b Gluteus maximus

c Gluteus minimus

d Quadratus femoris

e Obturator internus

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Anatomy: Hip and Thigh

Question 42 of 106

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a) Piriformis
b) Gluteus maximus
c) **Gluteus minimus** ✔
d) Quadratus femoris
e) Obturator internus

Answer

The gluteus medius and gluteus minimus muscles act to abduct and medially rotate the thigh at the hip joint. The gluteus maximus acts to extend, abduct and laterally rotate the thigh. The deep gluteal muscles (piriformis, obturator internus, gemelli and quadratus femoris muscles) are all synergistic lateral rotators of the thigh at the hip joint.

Notes

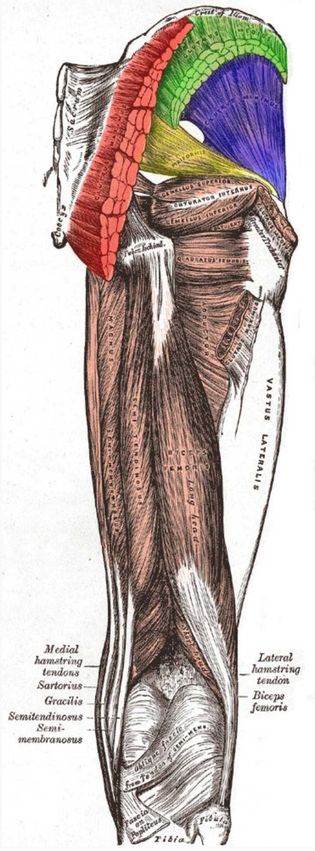
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 43 of 106

Imaging of a patient who has been involved in a car accident has shown damage to the nerve supplying the pectineus muscle. Which nerve is involved:

a Obturator nerve

b Femoral nerve

c Anterior rami of spinal nerves L1 – L3

d Pudendal nerve

e Inferior gluteal nerve

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Question 43 of 106

Imaging of a patient who has been involved in a car accident has shown damage to the nerve supplying the pectineus muscle. Which nerve is involved:

a) Obturator nerve
b) **Femoral nerve** ✔
c) Anterior rami of spinal nerves L1 – L3
d) Pudendal nerve
e) Inferior gluteal nerve

Answer

The pectineus (green) is innervated by the femoral nerve (L2, L3).

Notes

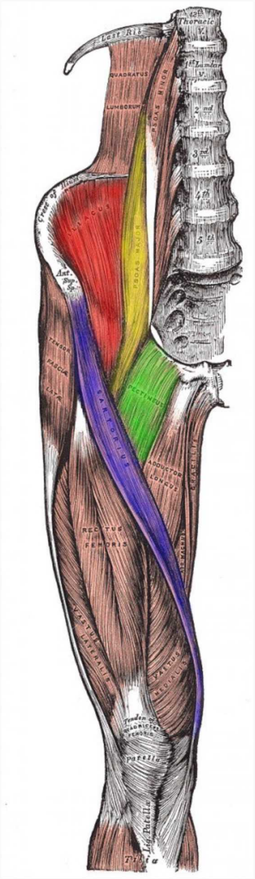
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 44 of 106

An 85 year old man is brought to the ED complaining of fever and pain in his right hip. You suspect a septic arthritis of the right hip joint. Which of the following synovial joint types best describes the hip joint:

a Synovial modified hinge joint

b Synovial pivot joint

c Synovial saddle joint

d Synovial ball and socket joint

e Synovial condyloid joint

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Anatomy: Hip and Thigh

Question 44 of 106

An 85 year old man is brought to the ED complaining of fever and pain in his right hip. You suspect a septic arthritis of the right hip joint. Which of the following synovial joint types best describes the hip joint:

a) Synovial modified hinge joint
b) Synovial pivot joint
c) Synovial saddle joint
d) **Synovial ball and socket joint** ✔
e) Synovial condyloid joint

Answer

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

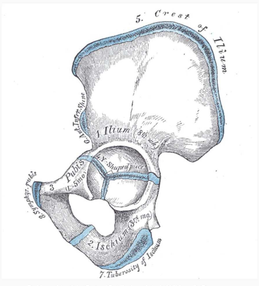
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

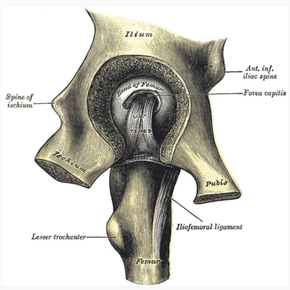


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

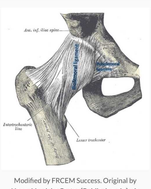
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 45 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered laterally by which of the following structures:

a Femoral artery

b Femoral nerve

c Femoral vein

d Femoral sheath

e Great saphenous vein

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Anatomy: Hip and Thigh

Question 45 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered laterally by which of the following structures:

a) Femoral artery
b) **Femoral nerve** ✗
c) Femoral vein ✓
d) Femoral sheath
e) Great saphenous vein

Answer

The femoral ring is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

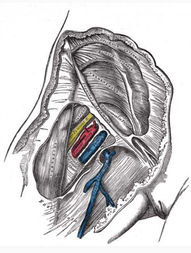
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The femoral triangle contains (from lateral to medial):

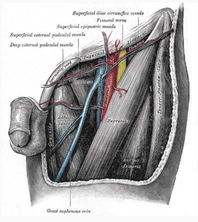
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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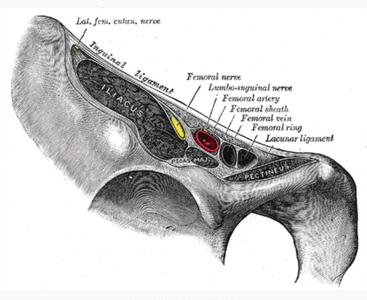
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 46 of 106

A 63 year old woman with advanced ovarian malignancy presents to ED complaining of weakness of her left leg while walking. Examination reveals weakness of adduction of the thigh at the hip joint. Which of the following nerves is most likely being compressed to result in this pattern:

a Sciatic nerve

b Femoral nerve

c Obturator nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 46 of 106

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a) Sciatic nerve
b) Femoral nerve
c) **Obturator nerve** ✔
d) Superior gluteal nerve
e) Inferior gluteal nerve

Answer

Adduction at the hip is primarily produced by the adductor longus, brevis and magnus, all innervated by the obturator nerve. The pectineus and gracilis muscles, innervated by the femoral nerve and obturator nerve respectively, assist in this action.

Notes

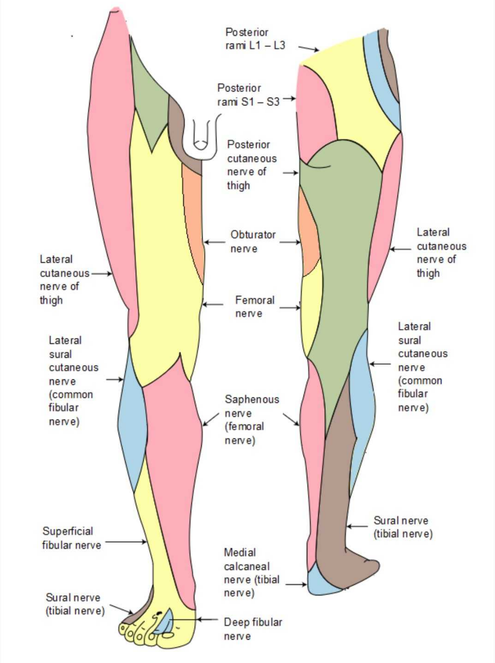
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 47 of 106

You are performing a thorough neurological examination of a 67 year old female patient. You note marked wasting of the left hip and thigh muscles, including the gluteus medius and minimus. The gluteus medius and gluteus minimus muscles are innervated by which of the following nerves:

a Superior gluteal nerve

b Inferior gluteal nerve

c Femoral nerve

d Sciatic nerve

e Pudendal nerve

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Anatomy: Hip and Thigh



Question 47 of 106

You are performing a thorough neurological examination of a 67 year old female patient. You note marked wasting of the left hip and thigh muscles, including the gluteus medius and minimus. The gluteus medius and gluteus minimus muscles are innervated by which of the following nerves:

a) **Superior gluteal nerve** ✔
b) Inferior gluteal nerve
c) Femoral nerve
d) Sciatic nerve
e) Pudendal nerve

Answer

The gluteus medius (green) and gluteus minimus (blue) are both innervated by the superior gluteal nerve (L4 – S1).

Notes

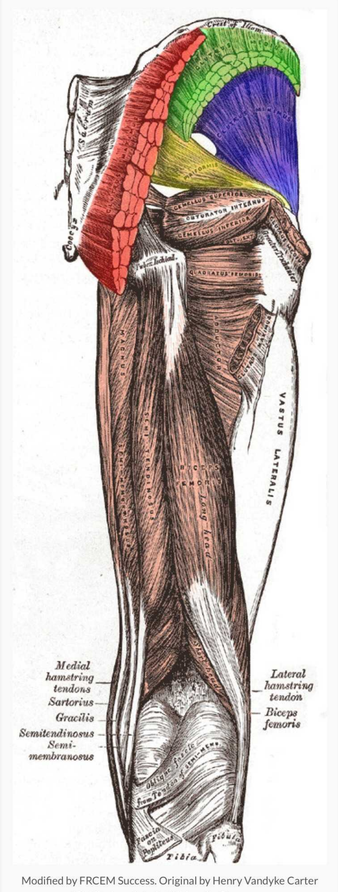
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 48 of 106

You suspect a patient of having weakness of the muscles of the medial compartment of the thigh. Which of the following tests would be most helpful to support your diagnosis:

a The leg is flexed against resistance

b The leg is flexed and laterally rotated against resistance

c The leg is extended and adducted against resistance

d The leg is extended and abducted against resistance

e The leg is extended and laterally rotated against resistance

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Anatomy: Hip and Thigh

Question 48 of 106

You suspect a patient of having weakness of the muscles of the medial compartment of the thigh. Which of the following tests would be most helpful to support your diagnosis:

a) The leg is flexed against resistance
b) The leg is flexed and laterally rotated against resistance
c) **The leg is extended and adducted against resistance** ✔
d) The leg is extended and abducted against resistance
e) The leg is extended and laterally rotated against resistance

Answer

There are six muscles in the medial compartment of the thigh: the gracilis, the pectineus, the adductor longus, brevis and magnus and the obturator externus. Other than the obturator externus, these muscles all act to adduct the thigh at the hip joint, therefore testing adduction against resistance is the most useful test of function.

Notes

There are six muscles in the medial compartment of the thigh: the gracilis, the pectineus, the adductor longus, brevis and magnus and the obturator externus. Other than the obturator externus, these muscles all act to adduct the thigh at the hip joint.

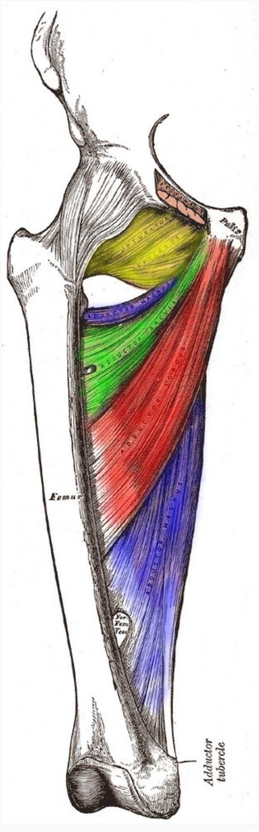
Testing of the medial thigh muscles can be performed with the patient lying supine and the knee straight. The patient is asked to adduct the thigh against resistance and the strength assessed (if the adductors are normal the proximal ends of the gracilis and adductor longus can easily be palpated).

Muscle	Action(s)	Innervation
Adductor longus (red)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4)
Adductor brevis (green)	Adduction and medial rotation at hip	Obturator nerve (L2, L3)
Adductor magnus (blue)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4), tibial nerve (L4 – S3)
Obturator externus (yellow)	Lateral rotation at hip	Obturator nerve (L3, L4)
Gracilis	Adduction at hip and flexion at knee	Obturator nerve (L2, L3)
Pectineus	Adduction and flexion at hip	Femoral nerve (L2, L3)

The adductor longus (red), brevis (green) and magnus (blue) are the prime adductors of the thigh at the hip joint and also assist in medial rotation.

The adductor muscles are innervated by the obturator nerve (L2 – L4), except for the hamstrings portion of the adductor magnus innervated by the tibial nerve (L4 – S3).

The obturator externus muscle (yellow) acts to laterally rotate the thigh at the hip joint. It is innervated by the obturator nerve (L3, L4).



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Anatomy: Hip and Thigh



Question 49 of 106

A 28 year old presents to the ED after sustaining a right knee injury whilst skiing. You examine the knee and suspect a medial meniscal injury. In addition to its bony attachments, the medial meniscus attaches to which of the following structures:

a Anterior cruciate ligament

b Posterior cruciate ligament

c Oblique popliteal ligament

d Tibial collateral ligament

e Fibular collateral ligament

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Anatomy: Hip and Thigh

Question 49 of 106

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a) Anterior cruciate ligament
b) Posterior cruciate ligament
c) Oblique popliteal ligament
d) **Tibial collateral ligament** ✔
e) Fibular collateral ligament

Answer

The two menisci are C-shaped fibrocartilaginous structures that lie between the femoral condyles and the tibia, attaching at each end to facets in the intercondylar region of the tibial plateau. In addition, the medial meniscus is also attached around its margin to the joint capsule and to the tibial collateral ligament, unlike the smaller, more mobile lateral meniscus. This means any damage to the tibial collateral ligament results in tearing of the medial meniscus.

Notes

Joint	Knee joint
Type	Modified hinge synovial joint
Articulations	Femoral condyles with tibial condyles (tibiofemoral articulation) and patella with anterior femur (patellofemoral articulation)
Stabilising factors	Fibrous capsule, tibial spines, menisci, tibial/fibular collateral ligament, anterior/posterior cruciate ligament, vastus medialis and lateralis muscles, oblique popliteal ligament, iliotibial tract, muscle tendons (hamstrings, gastrocnemius, sartorius, gracilis)
Movements	Flexion/Extension, Medial/Lateral rotation in flexed position

Joint articulations

The knee joint is formed from two articulations:

- the main weight bearing tibiofemoral articulation between the two femoral condyles and the adjacent surfaces of the superior aspect of the tibial condyles
- the patellofemoral articulation between the anterior femur and the patella which allows the pull of the quadriceps femoris muscle to be directed anteriorly over the knee to the tibia without tendon wear

Joint movements

The knee joint is a modified hinge synovial joint, allowing mainly flexion and extension, but also a small degree of medial and lateral rotation.

Movement	Muscles Involved
Flexion	Hamstrings, Gracilis, Sartorius, Gastrocnemius, Plantaris
Extension	Quadriceps femoris

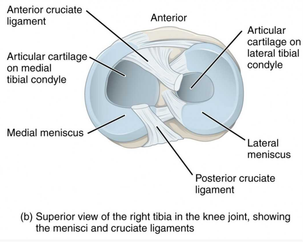
When standing, the knee joint is 'locked' in position to reduce the amount of muscle work needed to maintain the standing weight bearing position. This locking mechanism occurs partly due to the change in the shape/size of the articulating femoral surfaces (in the flexed position, the surfaces of the femoral condyles that articulate with the tibia are curved/round, but in extension, the surfaces are flat, and consequently the joint surfaces become larger and more stable in extension) and partly due to medial rotation of the femur on the tibia in full extension; medial rotation and full extension tightens all the associated ligaments (the screw home mechanism). Contraction of the popliteus muscle 'unlocks' the knee by initiating lateral rotation of the femur on the tibia, and allowing flexion.

Joint capsule

The fibrous membrane of the knee joint is reinforced anteriorly by the tendinous expansions of the vastus lateralis and vastus medialis muscles, anterolaterally by a fibrous extension from the iliotibial tract and posteromedially by the oblique popliteal ligament, an extension from the tendon of the semimembranosus muscle (the oblique popliteal ligament resists hyperextension and lateral rotation of the leg). The upper end of the popliteus muscle passes through an opening in the posterolateral aspect of the fibrous membrane of the knee.

Menisci

The two menisci are C-shaped fibrocartilaginous structures that lie between the femoral condyles and the tibia, attaching at each end to facets in the intercondylar region of the tibial plateau. In addition, the medial meniscus is also attached around its margin to the joint capsule and to the tibial collateral ligament, unlike the smaller, more mobile lateral meniscus. This means any damage to the tibial collateral ligament results in tearing of the medial meniscus. The menisci deepen the articular surface of the tibia increasing stability of the joint, improve congruence between the femoral and tibial condyles during joint movements and play an important role in shock absorption.



(b) Superior view of the right tibia in the knee joint, showing the menisci and cruciate ligaments

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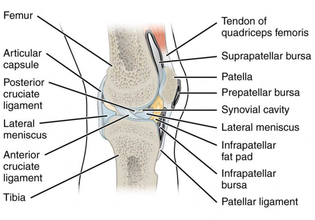
Ligaments

The tibial collateral ligament is attached proximally to the medial epicondyle of the femur and distally to the medial tibia. The fibular collateral ligament is attached proximally to the lateral condyle of the femur and distally to the lateral fibula. The tibial and fibular collateral ligaments act to stabilise the knee joint medially and laterally respectively, limiting extension and preventing adduction and abduction movements. The tibial collateral ligament is also attached to the medial meniscus; this means any damage to the tibial collateral ligament usually results in tearing of the medial meniscus.

The cruciate ligaments interconnect the adjacent ends of the femur and tibia and maintain their opposed positions during movement.

- The anterior cruciate ligament (the weaker of the two) attaches to the anterior part of the intercondylar area of the tibia and ascends posteriorly to attach to the lateral wall of the intercondylar fossa of the femur and acts to prevent anterior displacement of the tibia relative to the femur. The ligament is lax during flexion and taut during extension thus it may be torn when the knee is hyperextended (or by the application of a large force to the back of the knee with the joint partly flexed). The anterior drawer sign may be seen where there is forward sliding of the tibia on the femur.
- The posterior cruciate ligament (the stronger of the two) attaches to the posterior part of the intercondylar area of the tibia and ascends anteriorly to attach to the medial wall of the intercondylar fossa of the femur and acts to prevent posterior dislocation of the tibia relative to the femur. The ligament is lax during extension and taut during flexion and thus it may be torn in a hyperflexion injury, where a large force is applied to the tibia when the knee is flexed. The posterior drawer sign may be seen where there is backward sliding of the tibia on the femur.

The 'unhappy triad' typically occurs due to a lateral force to an extended knee, e.g. in a football tackle. It refers to injury of the anterior cruciate ligament (due to forward displacement of the tibia), the tibial collateral ligament (due to excessive abduction) and the medial meniscus (due to its attachment on the tibial collateral ligament).



(a) Sagittal section through the right knee joint

Bursae

The synovial membrane of the knee joint forms pouches in two locations to provide low-friction surfaces for the movement of tendons associated with the joint:

- The subpopliteal recess – extends posterolaterally and lies between the lateral meniscus and the tendon of the popliteus muscle
- The suprapatellar bursa extends superiorly between the distal end of the shaft of the femur and the quadriceps femoris muscle and tendon

Other bursae associated with the knee, but not normally communicating with the synovial joint, include the subcutaneous prepatellar bursa, the deep and subcutaneous infrapatellar bursae separated by the patella ligament, and numerous other bursae associated with tendons and ligaments around the knee joint. Housemaid's knee is inflammation of the prepatellar bursa, and Clergyman's knee is inflammation of the subcutaneous infrapatellar bursa.

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Anatomy: Hip and Thigh



Question 50 of 106

You have been asked to perform an arterial blood gas collection from a patient's femoral artery. The femoral triangle is bordered medially by which of the following structures:

a Adductor brevis muscle

b Adductor longus muscle

c Adductor magnus muscle

d Pectineus muscle

e Gracilis muscle

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Anatomy: Hip and Thigh

Question 50 of 106

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a) Adductor brevis muscle
b) **Adductor longus muscle** ✔
c) Adductor magnus muscle
d) Pectineus muscle
e) Gracilis muscle

Answer

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

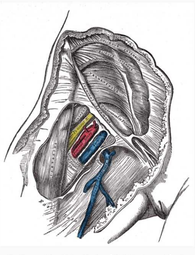
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The femoral triangle contains (from lateral to medial):

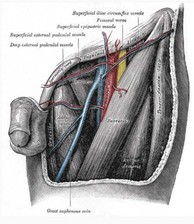
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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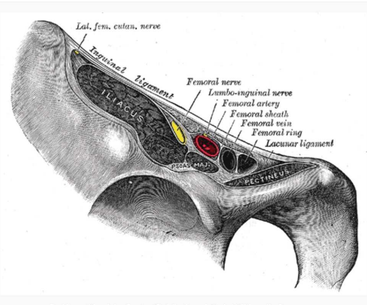
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 51 of 106

A 75 year old woman presents to the ED complaining of a loss of sensation to the skin over the anterior thigh. This area is primarily supplied by which of the following nerves:

a The medial cutaneous nerve of the thigh

b Cutaneous branches from the femoral nerve

c Cutaneous branches from the obturator nerve

d Cutaneous branches from the sciatic nerve

e Cutaneous branches from the lumbar plexus

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Anatomy: Hip and Thigh

Question 51 of 106

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a) The medial cutaneous nerve of the thigh
b) **Cutaneous branches from the femoral nerve** ✔
c) Cutaneous branches from the obturator nerve
d) Cutaneous branches from the sciatic nerve
e) Cutaneous branches from the lumbar plexus

Answer

The anterior cutaneous nerve, branch of the femoral nerve, supplies skin over the anterior thigh and anteromedial knee.

Notes

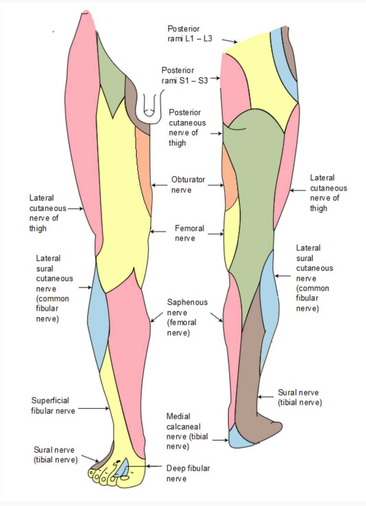
Nerve	Origin	Skin supplied
Lateral cutaneous nerve of thigh	Lumbar plexus (L2, L3)	Lateral thigh
Anterior cutaneous nerve	Femoral nerve	Anterior thigh and anteromedial knee
Cutaneous branch	Obturator nerve	Medial thigh
Posterior cutaneous nerve of thigh	Sacral plexus (S1 – S3)	Posterior thigh and upper leg
Saphenous nerve	Femoral nerve	Anteromedial knee, medial leg and foot
Lateral sural cutaneous nerve	Common fibular nerve	Upper lateral leg
Superficial fibular nerve	Common fibular nerve	Lower anterolateral leg and dorsum of foot
Deep fibular nerve	Common fibular nerve	Webspace between 1st and 2nd toe
Sural nerve	Tibial nerve	Lower posterolateral leg, heel and foot
Medial calcaneal nerve	Tibial nerve	Medial side and sole of heel
Medial and lateral plantar nerves	Tibial nerve	Sole of foot anterior to heel

Thigh:

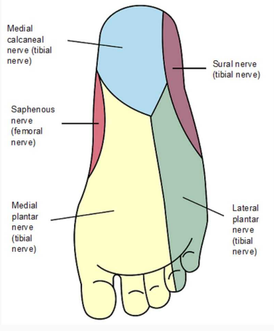
- The skin over the hip and gluteal region is supplied by the posterior and anterior rami of lumbosacral nerves (L1 – S3).
- The lateral cutaneous nerve of the thigh, nerve from the lumbar plexus, supplies skin over the lateral thigh.
- The anterior cutaneous nerve, branch of the femoral nerve, supplies skin over the anterior thigh and anteromedial knee.
- The obturator nerve supplies skin over the upper medial thigh.
- The posterior cutaneous nerve of the thigh, nerve from the sacral plexus, supplies skin over the posterior thigh and upper leg.

Leg:

- The saphenous nerve, branch of the femoral nerve, supplies the skin over the anteromedial knee, medial leg and the medial side of the foot as far anteriorly as the head of the 1st metatarsal.
- The lateral sural nerve, branch of the common fibular nerve, supplies the skin over the upper lateral leg.
- The superficial fibular nerve supplies the area of skin over the lower anterolateral leg and the dorsum of the foot (except for the webspace between the 1st and 2nd toe and the lateral side of the little toe).
- The deep fibular nerve supplies the skin over the webspace between the 1st and 2nd toe.
- The sural nerve, branch of the tibial nerve, supplies the skin over the lower posterolateral leg, heel and foot.
- The medial calcaneal nerve, branch of the tibial nerve, supplies the skin over the medial side and sole of the heel.
- The medial and lateral plantar nerves, branches of the tibial nerve, supply the skin over the sole of the foot anterior of the heel.



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Anatomy: Hip and Thigh



Question 52 of 106

A 35 year old woman presents to the Emergency Department with a painful swelling in her left groin. She is an intravenous drug user who regularly injects in the groins. On examination you note a tender, discharging mass highly suspicious of an abscess. You discuss the case with the on-call vascular team who are concerned about the possibility of a pseudoaneurysm of the femoral artery. The femoral artery is a continuation of which of the following arteries:

a Aorta

b Common iliac artery

c External iliac artery

d Internal iliac artery

e Obturator artery

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Anatomy: Hip and Thigh



Question 52 of 106

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a) Aorta
b) Common iliac artery
c) **External iliac artery** ✔
d) Internal iliac artery
e) Obturator artery

Answer

The femoral artery is the continuation of the external iliac artery.

Notes

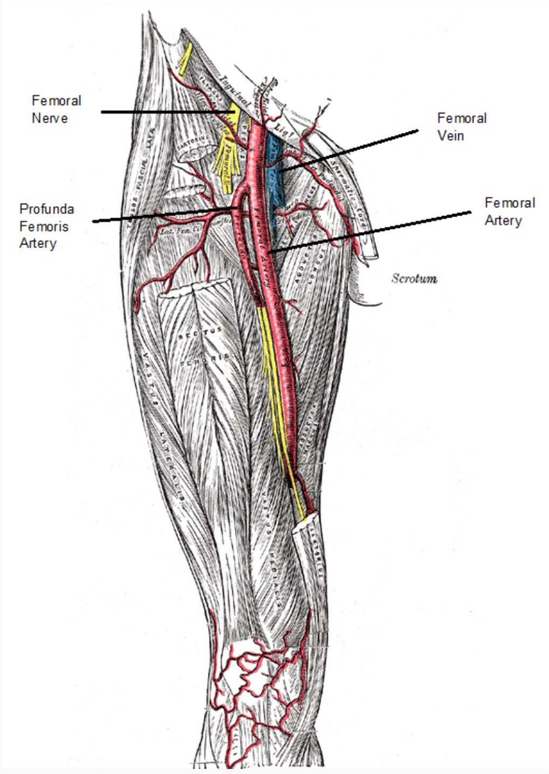
The major artery supplying the lower limb is the femoral artery. The femoral artery is the continuation of the external iliac artery, beginning as the vessel passes under the inguinal ligament to enter the femoral triangle in the anterior thigh.

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). The femoral vein lies immediately medial to this pulsation, which is an important landmark for central venous line insertion. Medial to the femoral vein is the femoral canal which contains lymphatics and lies immediately lateral to the pubic tubercle. The femoral nerve lies lateral to the femoral artery.

The femoral artery gives rise to the deep profunda femoris artery in the femoral triangle which is a major source of blood supply to the medial and posterior compartments of the thigh and the proximal femur.

After exiting the femoral triangle, the femoral artery continues down the anterior surface of the thigh via the adductor canal. During its descent it supplies the anterior thigh, giving rise to numerous superficial cutaneous branches.

The femoral artery becomes the popliteal artery after entering the posterior compartment of the thigh through the adductor hiatus just proximal to the knee.



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Anatomy: Hip and Thigh



Question 53 of 106

A 54 year old man presents to ED complaining of leg weakness. Your colleague has examined the patient and suspects femoral nerve palsy. Which of the following clinical features would you least expect to see on examination of this patient:

a Weakness of hip flexion

b Weakness of hip extension

c Weakness of knee extension

d Loss of sensation over anterior thigh

e Loss of sensation over medial leg and foot

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Question 53 of 106

A 54 year old man presents to ED complaining of leg weakness. Your colleague has examined the patient and suspects femoral nerve palsy. Which of the following clinical features would you least expect to see on examination of this patient:

a) Weakness of hip flexion
b) **Weakness of hip extension** ✔
c) Weakness of knee extension
d) Loss of sensation over anterior thigh
e) Loss of sensation over medial leg and foot

Answer

Damage to the femoral nerve results in weakness of hip flexion and knee extension and loss of sensation over the anterior thigh and the anteromedial knee, medial leg and medial foot.

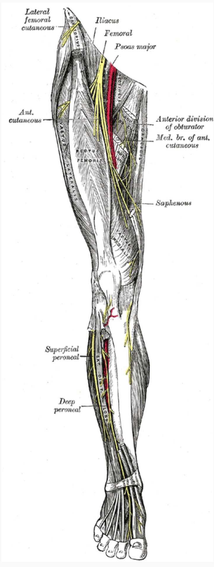
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

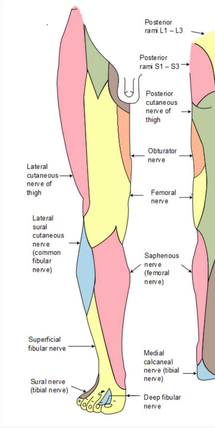
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Anatomy: Hip and Thigh



Question 54 of 106

A 34 year old man presents to the ED after sustaining multiple deep stab wounds during an altercation in a pub. Imagining has shown an injury to the femoral nerve. Which of the following best describes the anatomical course of the femoral nerve:

a After emerging from the lower lateral border of the psoas major muscle, the femoral nerve descends between the lateral border of the psoas major and the anterior surface of the iliacus muscle.

b After emerging from the lower border of the psoas major muscle, the femoral nerve descends posterior to the iliacus muscle.

c After emerging from the lower medial border of the psoas major muscle, the femoral nerve descends adjacent to the medial border of the psoas major muscle.

d The femoral nerve emerges from the lumbar plexus within the substance of the iliacus muscle.

e The femoral nerve descends in a groove between the psoas major and the psoas minor muscles.

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Anatomy: Hip and Thigh

Question 54 of 106

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a) ✔
After emerging from the lower lateral border of the psoas major muscle, the femoral nerve descends between the lateral border of the psoas major and the anterior surface of the iliacus muscle.

b)
After emerging from the lower border of the psoas major muscle, the femoral nerve descends posterior to the iliacus muscle.

c)
After emerging from the lower medial border of the psoas major muscle, the femoral nerve descends adjacent to the medial border of the psoas major muscle.

d) ✖
The femoral nerve emerges from the lumbar plexus within the substance of the iliacus muscle.

e) The femoral nerve descends in a groove between the psoas major and the psoas minor muscles.

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Answer

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.

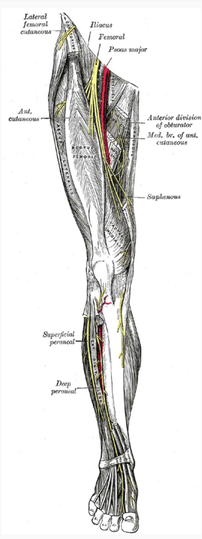
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

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Branches

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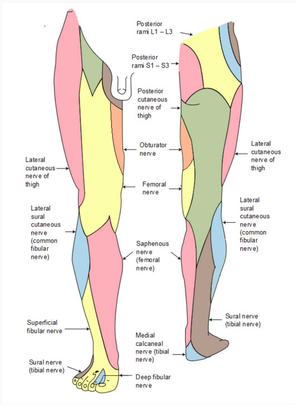
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The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

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Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
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Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Anatomy: Hip and Thigh



Question 55 of 106

A 19 year old man self presents to the ED following a fight in a nearby street. He has sustained multiple stab wounds and lacerations to the upper thigh and buttocks. Imaging shows an injury to the nerve supplying the obturator externus muscle. Which of the following movements is the patient most likely to find difficult:

a Lateral rotation of the thigh

b Medial rotation of the thigh

c Abduction of the thigh

d Adduction of the thigh

e Abduction and flexion of the thigh

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Anatomy: Hip and Thigh

Question 55 of 106

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a) Lateral rotation of the thigh ✔
b) Medial rotation of the thigh
c) **Abduction of the thigh** ✖
d) Adduction of the thigh
e) Abduction and flexion of the thigh

Answer

The obturator externus muscle (yellow) acts to laterally rotate the thigh at the hip joint.

Notes

There are six muscles in the medial compartment of the thigh: the gracilis, the pectineus, the adductor longus, brevis and magnus and the obturator externus. Other than the obturator externus, these muscles all act to adduct the thigh at the hip joint.

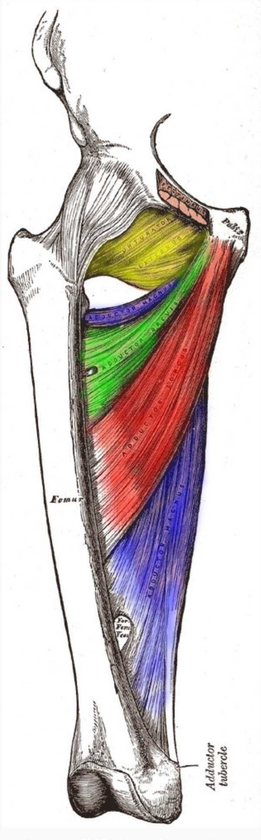
Testing of the medial thigh muscles can be performed with the patient lying supine and the knee straight. The patient is asked to adduct the thigh against resistance and the strength assessed (if the adductors are normal the proximal ends of the gracilis and adductor longus can easily be palpated).

Muscle	Action(s)	Innervation
Adductor longus (red)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4)
Adductor brevis (green)	Adduction and medial rotation at hip	Obturator nerve (L2, L3)
Adductor magnus (blue)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4), tibial nerve (L4 – S3)
Obturator externus (yellow)	Lateral rotation at hip	Obturator nerve (L3, L4)
Gracilis	Adduction at hip and flexion at knee	Obturator nerve (L2, L3)
Pectineus	Adduction and flexion at hip	Femoral nerve (L2, L3)

The adductor longus (red), brevis (green) and magnus (blue) are the prime adductors of the thigh at the hip joint and also assist in medial rotation.

The adductor muscles are innervated by the obturator nerve (L2 – L4), except for the hamstrings portion of the adductor magnus innervated by the tibial nerve (L4 – S3).

The obturator externus muscle (yellow) acts to laterally rotate the thigh at the hip joint. It is innervated by the obturator nerve (L3, L4).



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Anatomy: Hip and Thigh



Question 56 of 106

You are examining a 65 year old lady who has been brought in by ambulance with suspected hip dislocation. Which of the following ligaments is most significant in resisting hyperextension of the hip joint:

a Ischiofemoral ligament

b Pubofemoral ligament

c Iliofemoral ligament

d Ligament of the head of femur

e Transverse acetabular ligament

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Anatomy: Hip and Thigh

Question 56 of 106

You are examining a 65 year old lady who has been brought in by ambulance with suspected hip dislocation. Which of the following ligaments is most significant in resisting hyperextension of the hip joint:

a) Ischiofemoral ligament
b) Pubofemoral ligament
c) **Iliofemoral ligament** ✔
d) Ligament of the head of femur
e) Transverse acetabular ligament

Answer

The anterior iliofemoral ligament is the largest and strongest ligament at the hip and acts to resist hyperextension and lateral rotation of the femur at the hip joint. The anteroinferior pubofemoral ligament prevents excessive abduction and extension of the femur at the hip joint. The posterior ischiofemoral ligament prevents excessive extension and medial rotation of the femur at the hip joint.

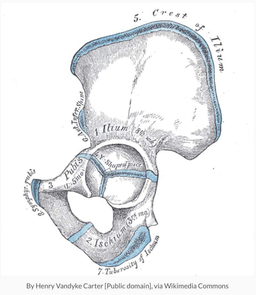
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

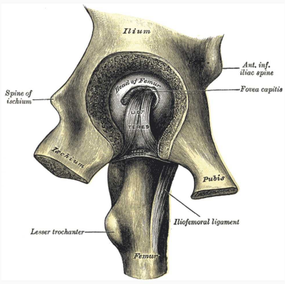


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 57 of 106

A 21 year old man presents to the ED after sustaining multiple deep lacerations to the posterior thigh during a fight. You suspect an injury to the hamstring muscles. Which of the following would best test the strength of the hamstring muscles:

a The leg is flexed against resistance

b The leg is extended against resistance

c The thigh is flexed against resistance

d The thigh is abducted against resistance

e The thigh is adducted against resistance

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Anatomy: Hip and Thigh

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a) **The leg is flexed against resistance** ✔
b) The leg is extended against resistance
c) The thigh is flexed against resistance
d) The thigh is abducted against resistance
e) The thigh is adducted against resistance

Answer

The hamstring muscles are best tested by the patient flexing their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.

Notes

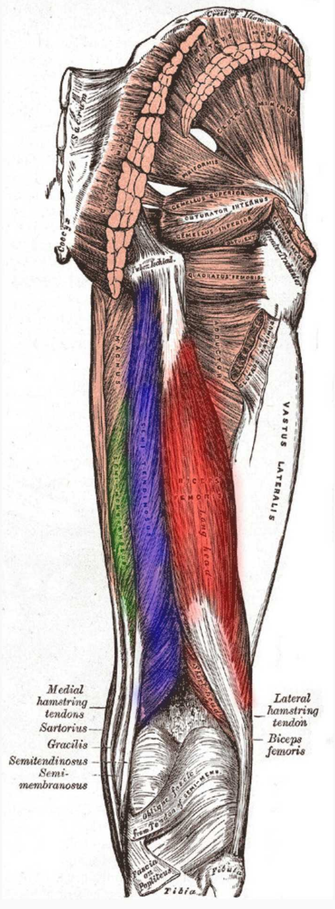
Muscle	Action(s)	Innervation
Biceps femoris (red)	Flexion at knee, extension and lateral rotation at hip	Sciatic nerve (L5 – S2)
Semitendinosus (blue)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)
Semimembranosus (green)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)

The hamstrings are composed of three individual muscles; the biceps femoris (red), the semitendinosus (blue) and the semimembranosus (green).

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

The hamstring muscles are all innervated by the tibial division of the sciatic nerve (L5 – S2), except for the short head of the biceps femoris innervated by the common fibular division.

To test the hamstrings the patient flexes their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.



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Anatomy: Hip and Thigh



Question 58 of 106

A patient with very poor peripheral access requires urgent intravenous fluids. The femoral vein in his groin is determined the most accessible vessel. Which of the following landmarks is the most accurate to identify the femoral vein:

a Just lateral to the femoral artery pulsation

b Just medial to the femoral artery pulsation

c Within the femoral canal

d Just medial to the femoral nerve

e Just lateral to the femoral nerve

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Question 58 of 106

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a) Just lateral to the femoral artery pulsation
b) **Just medial to the femoral artery pulsation** ✔
c) Within the femoral canal
d) Just medial to the femoral nerve
e) Just lateral to the femoral nerve

Answer

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). The femoral vein lies immediately medial to this pulsation.

Notes

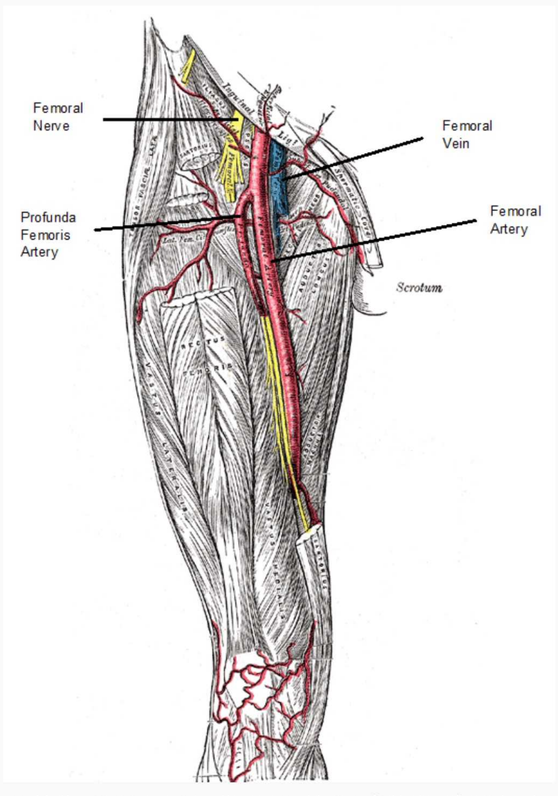
The major artery supplying the lower limb is the femoral artery. The femoral artery is the continuation of the external iliac artery, beginning as the vessel passes under the inguinal ligament to enter the femoral triangle in the anterior thigh.

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). The femoral vein lies immediately medial to this pulsation, which is an important landmark for central venous line insertion. Medial to the femoral vein is the femoral canal which contains lymphatics and lies immediately lateral to the pubic tubercle. The femoral nerve lies lateral to the femoral artery.

The femoral artery gives rise to the deep profunda femoris artery in the femoral triangle which is a major source of blood supply to the medial and posterior compartments of the thigh and the proximal femur.

After exiting the femoral triangle, the femoral artery continues down the anterior surface of the thigh via the adductor canal. During its descent it supplies the anterior thigh, giving rise to numerous superficial cutaneous branches.

The femoral artery becomes the popliteal artery after entering the posterior compartment of the thigh through the adductor hiatus just proximal to the knee.



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Anatomy: Hip and Thigh



Question 59 of 106

A 67 year old man presents to the ED complaining of pain and swelling to the posterior knee. On examination you note a tender swelling in the popliteal fossa. The popliteal fossa is bordered inferiorly by which of the following muscles:

a The plantaris and the soleus

b The gastrocnemius and the plantaris

c The gastrocnemius and the soleus

d The gastrocnemius and the popliteus

e The plantaris and the popliteus

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Anatomy: Hip and Thigh

Question 59 of 106

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a) The plantaris and the soleus
b) **The gastrocnemius and the plantaris** ✔
c) The gastrocnemius and the soleus
d) The gastrocnemius and the popliteus
e) The plantaris and the popliteus

Answer

The popliteal fossa is bordered inferomedially by the medial head of the gastrocnemius and inferolaterally by the lateral head of the gastrocnemius and plantaris.

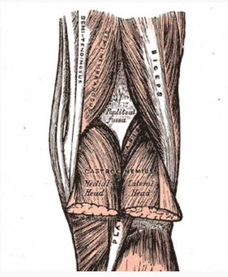
Notes

The popliteal fossa is a diamond-shaped space behind the knee joint.

Popliteal fossa	Structure(s)
Superomedial border	Semimembranosus
Superolateral border	Biceps femoris
Inferomedial border	Medial head of gastrocnemius
Inferolateral border	Lateral head of gastrocnemius and plantaris
Floor	Knee joint capsule and adjacent surfaces of femur and tibia and popliteus muscle
Roof	Deep fascia
Contents	Popliteal artery, popliteal vein, tibial nerve, common fibular nerve

The popliteal fossa is bordered:

- superomedially by the semimembranosus
- superolaterally by the biceps femoris
- inferomedially by the medial head of the gastrocnemius
- inferolaterally by the lateral head of the gastrocnemius and plantaris

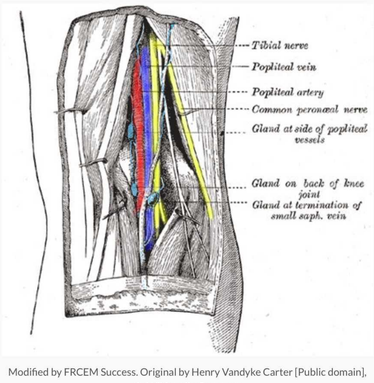


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The floor of the fossa is formed by the capsule of the knee joint and adjacent surfaces of the femur and tibia, and more inferiorly by the popliteus muscle. The roof is formed by deep fascia.

The major structures contained within the popliteal fossa are (from medial to lateral):

- the popliteal artery
- the popliteal vein
- the tibial nerve
- the common fibular nerve



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The small saphenous vein ascends in the superficial fascia on the back of the leg to the knee where it penetrates the deep fascia and enters the popliteal fossa to drain into the popliteal vein. One other structure that passes through the roof of the fossa is the posterior cutaneous nerve of the thigh which descends through the thigh superficial to the hamstring muscles, passes through the roof of the popliteal fossa, and then continues inferiorly with the small saphenous vein to supply skin on the upper half of the posterior leg.

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Anatomy: Hip and Thigh



Question 60 of 106

You are performing a full neurological examination on a patient who presented with weakness of her left leg. The tendon of which of the following muscles is stretched during the patellar reflex:

a Sartorius

b Gracilis

c Popliteus

d Biceps femoris

e Quadriceps femoris

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Anatomy: Hip and Thigh



Question 60 of 106

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a) Sartorius
b) Gracilis
c) Popliteus
d) Biceps femoris
e) **Quadriceps femoris** ✔

Answer

The quadriceps femoris tendon is continuous distally with the patella ligament which is attached to the tibial tuberosity distally.

Notes

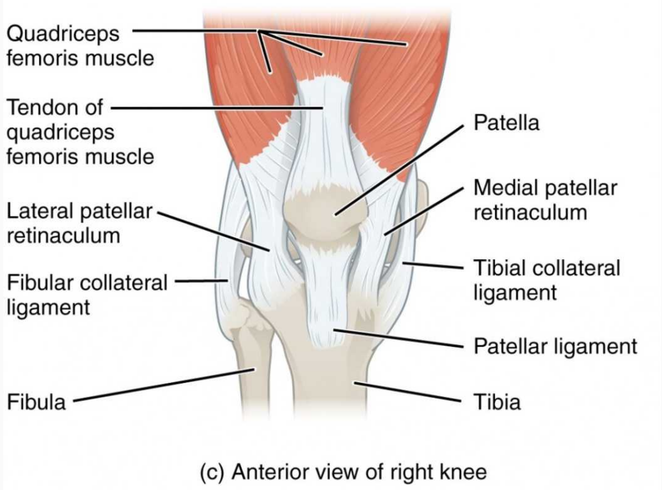
The patella is a sesamoid bone embedded in the quadriceps femoris tendon which sits in the trochlear groove of the anterior femur. The patella acts to magnify the force exerted by the quadriceps femoris and to redirect the quadriceps force as it undergoes normal lateral tracking during flexion.

The medial and lateral patellar retinaculum are formed primarily from fibres of the vastus medialis muscle, and the vastus lateralis muscle and iliotibial tract respectively, and attach the patella margins to surrounding fascia.

There are several structures that work together to keep the patella aligned and stabilised on the femur to prevent excessive lateral movement of the patella:

- The lateral femoral condyle on the lateral aspect of the trochlear groove is normally slightly higher than the medial aspect, providing a buttress to the patella on the lateral side.
- The vastus medialis muscle on the medial thigh acts to draw the patella in a medial direction. If the vastus medialis muscle is not strong enough, the patella is much more susceptible to dislocation.
- The medial patellofemoral ligament, extending from the medial aspect of the patella to the medial femoral condyle, provides a significant force (about 60%) against lateral displacement.

The quadriceps femoris tendon is continuous distally with the patella ligament which is attached to the tibial tuberosity distally.



(c) Anterior view of right knee

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Anatomy: Hip and Thigh



Question 61 of 106

A 43 year old man presents to the ED complaining of weakness at the right knee. On examination you note he is unable to extend the leg at the knee joint. Which of the following nerves is most important for extension of the leg at the knee joint:

a Obturator nerve

b Femoral nerve

c Sciatic nerve

d Inferior gluteal nerve

e Common fibular nerve

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a) Obturator nerve
b) **Femoral nerve** ✔
c) Sciatic nerve
d) Inferior gluteal nerve
e) Common fibular nerve

Answer

Extension of the leg at the knee joint is primarily produced by the quadriceps femoris muscles, innervated by the femoral nerve.

Notes

Joint	Knee joint
Type	Modified hinge synovial joint
Articulations	Femoral condyles with tibial condyles (tibiofemoral articulation) and patella with anterior femur (patellofemoral articulation)
Stabilising factors	Fibrous capsule, tibial spines, menisci, tibial/fibular collateral ligament, anterior/posterior cruciate ligament, vastus medialis and lateralis muscles, oblique popliteal ligament, iliotibial tract, muscle tendons (hamstrings, gastrocnemius, sartorius, gracilis)
Movements	Flexion/Extension, Medial/Lateral rotation in flexed position

Joint articulations

The knee joint is formed from two articulations:

- the main weight bearing tibiofemoral articulation between the two femoral condyles and the adjacent surfaces of the superior aspect of the tibial condyles
- the patellofemoral articulation between the anterior femur and the patella which allows the pull of the quadriceps femoris muscle to be directed anteriorly over the knee to the tibia without tendon wear

Joint movements

The knee joint is a modified hinge synovial joint, allowing mainly flexion and extension, but also a small degree of medial and lateral rotation.

Movement	Muscles Involved
Flexion	Hamstrings, Gracilis, Sartorius, Gastrocnemius, Plantaris
Extension	Quadriceps femoris

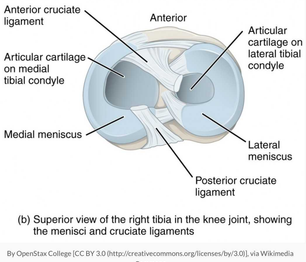
When standing, the knee joint is 'locked' in position to reduce the amount of muscle work needed to maintain the standing weight bearing position. This locking mechanism occurs partly due to the change in the shape/size of the articulating femoral surfaces (in the flexed position, the surfaces of the femoral condyles that articulate with the tibia are curved/round, but in extension, the surfaces are flat, and consequently the joint surfaces become larger and more stable in extension) and partly due to medial rotation of the femur on the tibia in full extension; medial rotation and full extension tightens all the associated ligaments (the screw home mechanism). Contraction of the popliteus muscle 'unlocks' the knee by initiating lateral rotation of the femur on the tibia, and allowing flexion.

Joint capsule

The fibrous membrane of the knee joint is reinforced anteriorly by the tendinous expansions of the vastus lateralis and vastus medialis muscles, anterolaterally by a fibrous extension from the iliotibial tract and posteromedially by the oblique popliteal ligament, an extension from the tendon of the semimembranosus muscle (the oblique popliteal ligament resists hyperextension and lateral rotation of the leg). The upper end of the popliteus muscle passes through an opening in the posterolateral aspect of the fibrous membrane of the knee.

Menisci

The two menisci are C-shaped fibrocartilaginous structures that lie between the femoral condyles and the tibia, attaching at each end to facets in the intercondylar region of the tibial plateau. In addition, the medial meniscus is also attached around its margin to the joint capsule and to the tibial collateral ligament, unlike the smaller, more mobile lateral meniscus. This means any damage to the tibial collateral ligament results in tearing of the medial meniscus. The menisci deepen the articular surface of the tibia increasing stability of the joint, improve congruence between the femoral and tibial condyles during joint movements and play an important role in shock absorption.



(b) Superior view of the right tibia in the knee joint, showing the menisci and cruciate ligaments

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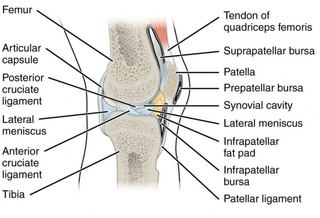
Ligaments

The tibial collateral ligament is attached proximally to the medial epicondyle of the femur and distally to the medial tibia. The fibular collateral ligament is attached proximally to the lateral condyle of the femur and distally to the lateral fibula. The tibial and fibular collateral ligaments act to stabilise the knee joint medially and laterally respectively, limiting extension and preventing adduction and abduction movements. The tibial collateral ligament is also attached to the medial meniscus; this means any damage to the tibial collateral ligament usually results in tearing of the medial meniscus.

The cruciate ligaments interconnect the adjacent ends of the femur and tibia and maintain their opposed positions during movement.

- The anterior cruciate ligament (the weaker of the two) attaches to the anterior part of the intercondylar area of the tibia and ascends posteriorly to attach to the lateral wall of the intercondylar fossa of the femur and acts to prevent anterior displacement of the tibia relative to the femur. The ligament is lax during flexion and taut during extension thus it may be torn when the knee is hyperextended (or by the application of a large force to the back of the knee with the joint partly flexed). The anterior drawer sign may be seen where there is forward sliding of the tibia on the femur.
- The posterior cruciate ligament (the stronger of the two) attaches to the posterior part of the intercondylar area of the tibia and ascends anteriorly to attach to the medial wall of the intercondylar fossa of the femur and acts to prevent posterior dislocation of the tibia relative to the femur. The ligament is lax during extension and taut during flexion and thus it may be torn in a hyperflexion injury, where a large force is applied to the tibia when the knee is flexed. The posterior drawer sign may be seen where there is backward sliding of the tibia on the femur.

The 'unhappy triad' typically occurs due to a lateral force to an extended knee, e.g. in a football tackle. It refers to injury of the anterior cruciate ligament (due to forward displacement of the tibia), the tibial collateral ligament (due to excessive abduction) and the medial meniscus (due to its attachment on the tibial collateral ligament).



(a) Sagittal section through the right knee joint

Bursae

The synovial membrane of the knee joint forms pouches in two locations to provide low-friction surfaces for the movement of tendons associated with the joint:

- The subpopliteal recess – extends posterolaterally and lies between the lateral meniscus and the tendon of the popliteus muscle
- The suprapatellar bursa extends superiorly between the distal end of the shaft of the femur and the quadriceps femoris muscle and tendon

Other bursae associated with the knee, but not normally communicating with the synovial joint, include the subcutaneous prepatellar bursa, the deep and subcutaneous infrapatellar bursae separated by the patella ligament, and numerous other bursae associated with tendons and ligaments around the knee joint. Housemaid's knee is inflammation of the prepatellar bursa, and Clergyman's knee is inflammation of the subcutaneous infrapatellar bursa.

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Anatomy: Hip and Thigh



Question 62 of 106

You are performing a thorough neurological examination of a 67 year old female patient. You note marked wasting of the left hip and thigh muscles, including the gluteus medius and minimus. The gluteus medius and gluteus minimus muscles primarily act to produce which of the following movements:

a Abduction and medial rotation of the thigh

b Adduction and medial rotation of the thigh

c Extension and medial rotation of the thigh

d Extension and abduction of the thigh

e Extension of the thigh

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Anatomy: Hip and Thigh

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a) **Abduction and medial rotation of the thigh** ✔
b) Adduction and medial rotation of the thigh
c) Extension and medial rotation of the thigh
d) Extension and abduction of the thigh
e) Extension of the thigh

Answer

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking.

Notes

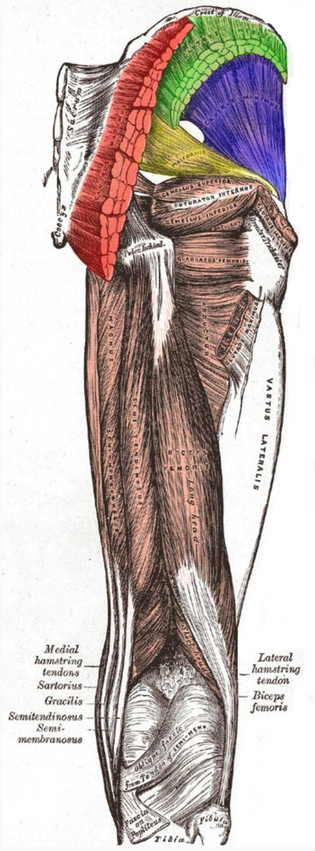
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 63 of 106

A 21 year old male is involved in a road traffic collision and sustains a pelvic fracture. In rehabilitation it is noted that he has an inability to adduct his thigh. Which of the following nerves has most likely been affected:

a Obturator nerve

b Femoral nerve

c Inferior gluteal nerve

d Superior gluteal nerve

e Sciatic nerve

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Anatomy: Hip and Thigh

Question 63 of 106

A 21 year old male is involved in a road traffic collision and sustains a pelvic fracture. In rehabilitation it is noted that he has an inability to adduct his thigh. Which of the following nerves has most likely been affected:

a) **Obturator nerve** ✔
b) Femoral nerve
c) Inferior gluteal nerve
d) Superior gluteal nerve
e) Sciatic nerve

Answer

Adduction of the thigh is primarily produced by the adductor longus, magnus and brevis muscles and the gracilis muscle, all innervated by the obturator nerve.

Notes

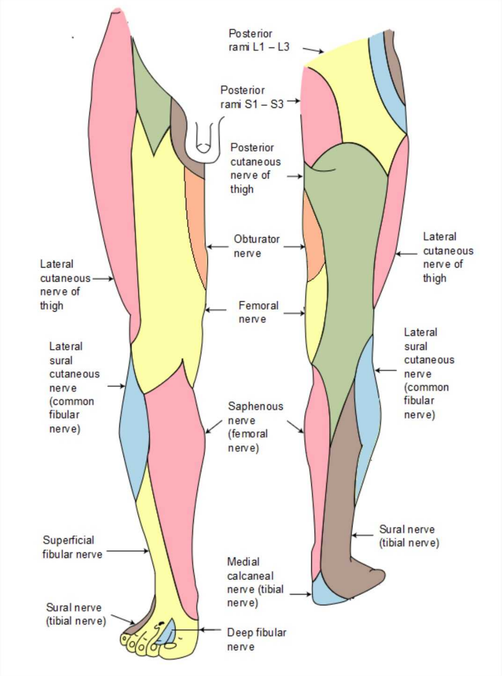
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 64 of 106

A 27 year old woman presents to the Emergency Department complaining of progressive weakness in her lower limbs following a recent episode of food poisoning. You are asked to perform a full neurological examination of the lower limbs, including testing sensation in all dermatomes. The S3 dermatome is best tested at which of the following landmarks:

a At the midpoint of the inguinal ligament

b At the ischial tuberosity

c At the pubic symphysis

d At the popliteal fossa

e At the medial femoral condyle

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Anatomy: Hip and Thigh

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a) At the midpoint of the inguinal ligament
b) **At the ischial tuberosity** ✔
c) At the pubic symphysis
d) At the popliteal fossa
e) At the medial femoral condyle

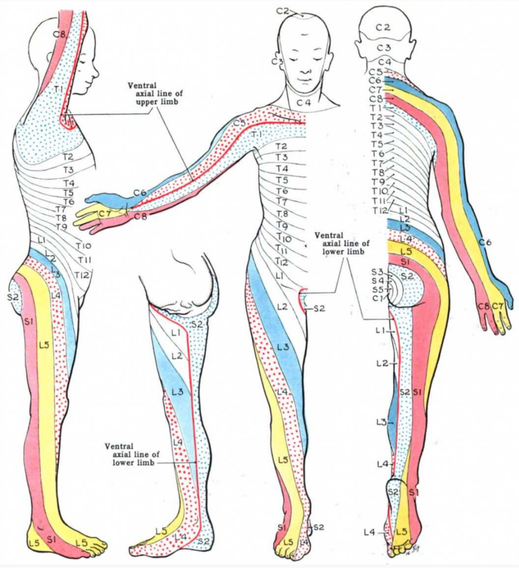
Answer

The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).

Notes

Dermatome	Landmark
L1	Upper Anterior Thigh
L2	Mid Anterior Thigh
L3	Medial Femoral Condyle
L4	Medial Malleolus
L5	Dorsum 3rd MTP Joint
S1	Lateral Heel
S2	Popliteal Fossa
S3	Ischial Tuberosity
S5	Perianal Area

- The T12 dermatome is best tested at the midclavicular line, over the midpoint of the inguinal ligament.
- The L1 dermatome is best tested on the upper anterior thigh, at a point midway between the key sensory points for T12 and L2.
- The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.
- The L3 dermatome is best tested at the medial femoral condyle above the knee.
- The L4 dermatome is best tested over the medial malleolus.
- The L5 dermatome is best tested on the dorsum of the foot at the third metatarsophalangeal joint.
- The S1 dermatome is best tested on the lateral aspect of the calcaneus.
- The S2 dermatome is best tested at the midpoint of the popliteal fossa.
- The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).
- The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.



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Anatomy: Hip and Thigh



Question 65 of 106

A 23 year old rugby player presents to the ED complaining of ongoing thigh pain following a match 3 days ago. Imaging has been arranged which shows a traumatic injury to the rectus femoris. The rectus femoris muscle acts primarily to produce which of the following movements:

a Flexion at hip and flexion at knee

b Flexion at hip and extension at knee

c Extension at hip and flexion at knee

d Extension at hip and extension at knee

e Flexion at knee

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Question 65 of 106

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a) Flexion at hip and flexion at knee
b) **Flexion at hip and extension at knee** ✔
c) Extension at hip and flexion at knee
d) Extension at hip and extension at knee
e) Flexion at knee

Answer

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

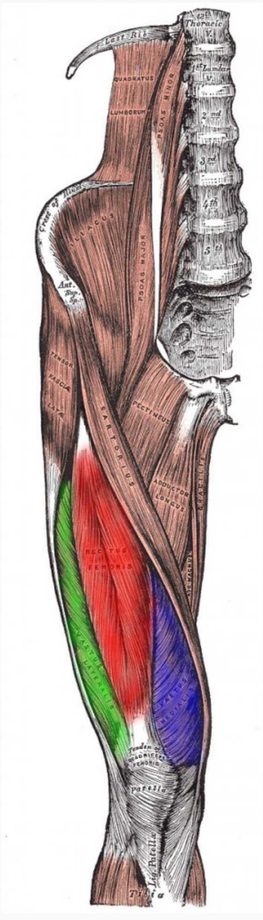
Notes

Muscle	Action(s)	Innervation
Rectus femoris (red)	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)
Vastus lateralis (green)	Extension at knee	Femoral nerve (L2 – L4)
Vastus medialis (blue)	Extension at knee	Femoral nerve (L2 – L4)
Vastus intermedius	Extension at knee	Femoral nerve (L2 – L4)

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. Because the vastus muscles insert into the margins of the patella as well as into the quadriceps femoris tendon, they stabilise the position of the patella during knee joint movement.

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4). A tap on the patella ligament tests reflex activity mainly at spinal cord levels L3/L4.



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Anatomy: Hip and Thigh



Question 66 of 106

You form part of the trauma team caring for a roofer who fell approximately 7 metres from a roof, landing across a beam. Imaging of the spine has revealed traumatic injuries to multiple lumbar vertebrae and the femoral nerve. Which of the following muscles is NOT innervated by the femoral nerve:

a Pectineus

b Sartorius

c Iliacus

d Quadriceps femoris

e Psoas major

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a) Pectineus
b) Sartorius
c) Iliacus
d) Quadriceps femoris
e) **Psoas major** ✔

Answer

The femoral nerve innervates the iliacus, the pectineus, the sartorius and the quadriceps femoris muscles. The psoas major is innervated by the anterior rami of L1 – L3.

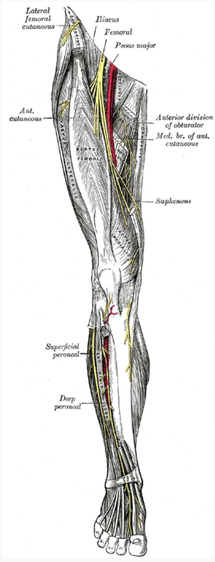
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

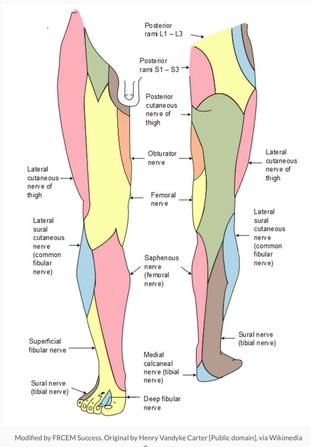
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Anatomy: Hip and Thigh



Question 67 of 106

A 54 year old woman is brought into the ED following a multiple vehicle collision on the nearby motorway. She is haemodynamically stable and the trauma team arrange imaging. Amongst other injuries she has transected the nerve that supplies the gracilis muscle. The gracilis muscle acts to produce which of the following movements:

a Adduction of the thigh and flexion of the leg

b Abduction of the thigh and flexion of the leg

c Flexion of the thigh and flexion of the leg

d Adduction and flexion of the thigh

e Flexion of the thigh and extension of the leg

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a) Adduction of the thigh and flexion of the leg ✔
b) Abduction of the thigh and flexion of the leg
c) Flexion of the thigh and flexion of the leg
d) **Adduction and flexion of the thigh** ✖
e) Flexion of the thigh and extension of the leg

Answer

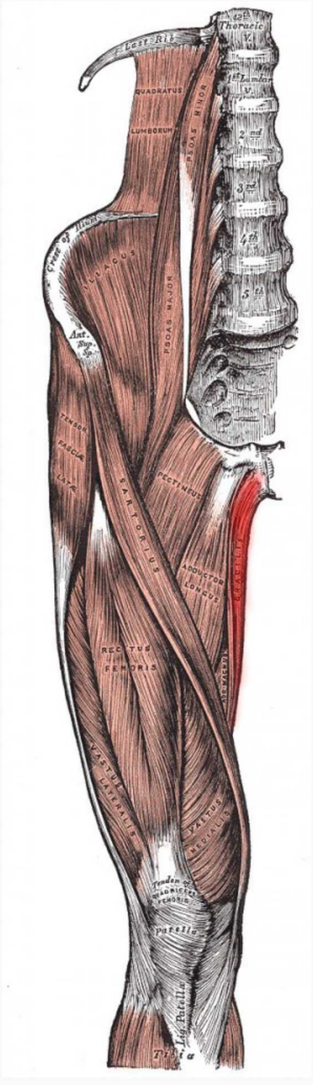
The gracilis acts to adduct the thigh at the hip joint and flex the leg at the knee joint.

Notes

The gracilis muscle is a muscle of the medial compartment of the thigh.

The gracilis acts to adduct the thigh at the hip joint and flex the leg at the knee joint.

It is innervated by the obturator nerve (L2, L3).



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Anatomy: Hip and Thigh



Question 68 of 106

A 21 year old male presents to ED having sustained a stab wound to his left buttock. You note that he walks with a waddling gait, with the pelvis falling towards the right side with each step. Which of the following nerves was most likely injured:

a Sciatic nerve

b Obturator nerve

c Femoral nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 68 of 106

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a) Sciatic nerve
b) Obturator nerve
c) Femoral nerve
d) **Superior gluteal nerve** ✔
e) Inferior gluteal nerve

Answer

This describes Trendelenburg gait, which is caused by weakness of the gluteus medius and gluteus minimus muscles, innervated by the superior gluteal nerve. These gluteal muscles normally function to abduct the thigh and stabilise the pelvis when the opposite foot is off the ground. In damage to the superior gluteal nerve, the weakened muscles allow the pelvis to tilt down on the opposite side.

Notes

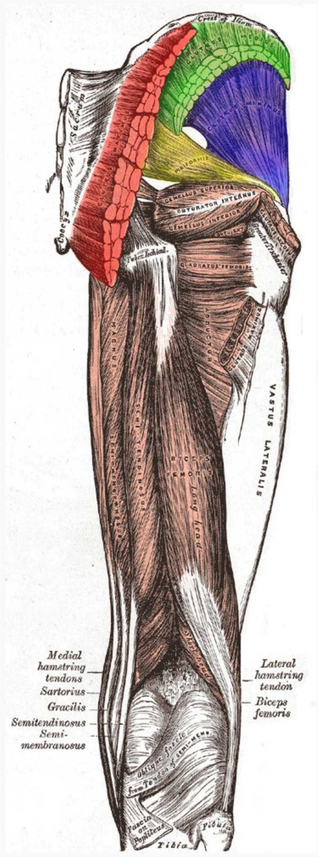
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 69 of 106

A 67 year old man presents to the ED complaining of pain and swelling to the posterior knee. On examination you note a tender swelling in the popliteal fossa. The popliteal fossa is bordered superiorly by which of the following muscles:

a The semimembranosus and the semitendinosus

b The biceps femoris and the plantaris

c The biceps femoris and the semimembranosus

d The biceps femoris alone

e The semitendinosus alone

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Question 69 of 106

A 67 year old man presents to the ED complaining of pain and swelling to the posterior knee. On examination you note a tender swelling in the popliteal fossa. The popliteal fossa is bordered superiorly by which of the following muscles:

a) The semimembranosus and the semitendinosus
b) The biceps femoris and the plantaris
c) **The biceps femoris and the semimembranosus** ✔
d) The biceps femoris alone
e) The semitendinosus alone

Answer

The popliteal fossa is bordered superomedially by the semimembranosus and superolaterally by the biceps femoris.

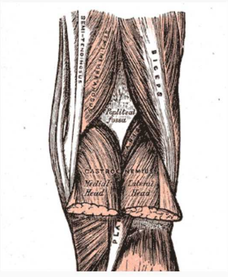
Notes

The popliteal fossa is a diamond-shaped space behind the knee joint.

Popliteal fossa	Structure(s)
Superomedial border	Semimembranosus
Superolateral border	Biceps femoris
Inferomedial border	Medial head of gastrocnemius
Inferolateral border	Lateral head of gastrocnemius and plantaris
Floor	Knee joint capsule and adjacent surfaces of femur and tibia and popliteus muscle
Roof	Deep fascia
Contents	Popliteal artery, popliteal vein, tibial nerve, common fibular nerve

The popliteal fossa is bordered:

- superomedially by the semimembranosus
- superolaterally by the biceps femoris
- inferomedially by the medial head of the gastrocnemius
- inferolaterally by the lateral head of the gastrocnemius and plantaris

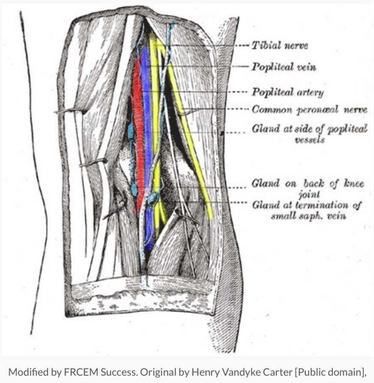


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The floor of the fossa is formed by the capsule of the knee joint and adjacent surfaces of the femur and tibia, and more inferiorly by the popliteus muscle. The roof is formed by deep fascia.

The major structures contained within the popliteal fossa are (from medial to lateral):

- the popliteal artery
- the popliteal vein
- the tibial nerve
- the common fibular nerve



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The small saphenous vein ascends in the superficial fascia on the back of the leg to the knee where it penetrates the deep fascia and enters the popliteal fossa to drain into the popliteal vein. One other structure that passes through the roof of the fossa is the posterior cutaneous nerve of the thigh which descends through the thigh superficial to the hamstring muscles, passes through the roof of the popliteal fossa, and then continues inferiorly with the small saphenous vein to supply skin on the upper half of the posterior leg.

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Anatomy: Hip and Thigh



Question 70 of 106

A 34 year old farmer has sustained a deep laceration to the popliteal fossa and damaged the more medial nerve. Which of the following clinical features are you mostly likely to see on examination:

a Loss of extension of the leg at the knee joint

b Loss of flexion of the leg at the knee joint

c Weakness of plantarflexion and inversion

d Weakness of dorsiflexion and eversion

e Foot drop

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a) Loss of extension of the leg at the knee joint
b) Loss of flexion of the leg at the knee joint
c) **Weakness of plantarflexion and inversion** ✔
d) Weakness of dorsiflexion and eversion
e) Foot drop

Answer

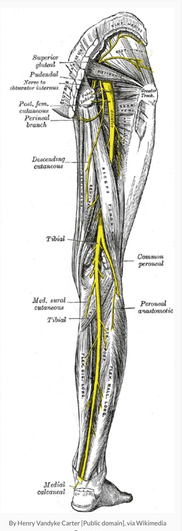
The tibial nerve and the common fibular nerve both lie in the popliteal fossa, but the tibial nerve lies more medially. The tibial nerve innervates the muscles in the posterior compartment of the leg, which act primarily to produce plantarflexion of the foot at the ankle, but also assist in flexion of the leg at the knee and inversion of the foot. You would not expect loss of flexion of the leg at the knee because this is mainly produced by the hamstrings, but you might see weakness of this movement.

Notes

The tibial nerve is a branch of the sciatic nerve receiving nerve fibres from L4 – S3.

Nerve	Tibial nerve
Nerve roots	L4 – S3
Motor supply	All muscles in the posterior compartment of the leg and the intrinsic muscles in the sole of the foot
Sensory supply	Skin on the posterolateral side of the lower leg, the lateral side of the ankle, foot and little toe, the medial side of the heel, foot and toes
Injury	Weakness of flexion of knee, loss of plantarflexion of ankle and flexion of toes, weakness of foot inversion and loss of sensation in distribution above

It arises at the apex of the popliteal fossa before descending in the leg to enter the popliteal fossa posterior to the knee. The tibial nerve then passes under the tendinous arch formed by the two heads of the soleus muscle and then descends through the deep region of the posterior compartment of the leg. The tibial nerve passes through the tarsal tunnel, posterior to the medial malleolus to enter to foot.

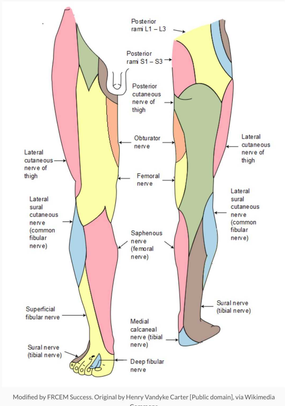


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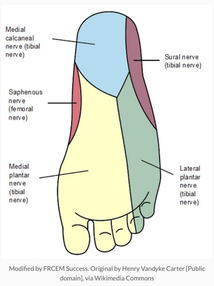
Through its muscular branches, the tibial nerve innervates all of the muscles in the posterior compartment of the leg. The tibial nerve gives rise to the sural nerve in the proximal leg which supplies skin on the lower posterolateral surface of the leg, and the lateral side of the ankle, foot and little toe, and the medial calcaneal nerve in the distal leg which supplies skin on the medial surface and sole of the heel. In the foot the tibial nerve divides into the medial and lateral plantar nerves which innervate all of the intrinsic muscles of the sole of the foot and supply skin over the medial and lateral sole of foot and toes respectively.

Branch	Innervation
Muscular branches	Posterior compartment of leg
Sural nerve	Skin on lower posterolateral leg, lateral side of ankle, foot and little toe
Medial calcaneal nerve	Skin on medial surface and sole of heel
Plantar nerves	Intrinsic muscles in sole of foot, skin over sole of foot and toes

Muscle	Action(s)
Gastrocnemius	Plantarflexion of foot and flexion of leg
Plantaris	Plantarflexion of foot and flexion of leg
Soleus	Plantarflexion of foot
Flexor digitorum longus	Flexion of lateral four toes
Flexor hallucis longus	Flexion of great toe and plantarflexion of foot
Tibialis posterior	Plantarflexion and inversion of foot, support of medial arch



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Anatomy: Hip and Thigh



Question 71 of 106

A 32 year old builder is brought to the ED after falling through a glass sky light onto the floor below. A primary survey has been performed and the patient is stable enough to undergo imaging. Imaging shows multiple injuries including a transection of the nerve supplying the adductor longus, magnus and brevis muscles. Which nerve has been injured:

a Sciatic nerve

b Obturator nerve

c Femoral nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 71 of 106

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a) Sciatic nerve
b) **Obturator nerve** ✔
c) Femoral nerve
d) Superior gluteal nerve
e) Inferior gluteal nerve

Answer

The adductor muscles are innervated by the obturator nerve (L2 – L4), except for the hamstrings portion of the adductor magnus innervated by the tibial nerve (L4 – S3).

Notes

There are six muscles in the medial compartment of the thigh: the gracilis, the pectineus, the adductor longus, brevis and magnus and the obturator externus. Other than the obturator externus, these muscles all act to adduct the thigh at the hip joint.

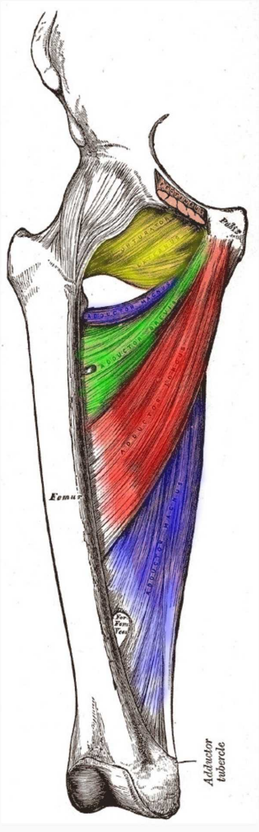
Testing of the medial thigh muscles can be performed with the patient lying supine and the knee straight. The patient is asked to adduct the thigh against resistance and the strength assessed (if the adductors are normal the proximal ends of the gracilis and adductor longus can easily be palpated).

Muscle	Action(s)	Innervation
Adductor longus (red)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4)
Adductor brevis (green)	Adduction and medial rotation at hip	Obturator nerve (L2, L3)
Adductor magnus (blue)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4), tibial nerve (L4 – S3)
Obturator externus (yellow)	Lateral rotation at hip	Obturator nerve (L3, L4)
Gracilis	Adduction at hip and flexion at knee	Obturator nerve (L2, L3)
Pectineus	Adduction and flexion at hip	Femoral nerve (L2, L3)

The adductor longus (red), brevis (green) and magnus (blue) are the prime adductors of the thigh at the hip joint and also assist in medial rotation.

The adductor muscles are innervated by the obturator nerve (L2 – L4), except for the hamstrings portion of the adductor magnus innervated by the tibial nerve (L4 – S3).

The obturator externus muscle (yellow) acts to laterally rotate the thigh at the hip joint. It is innervated by the obturator nerve (L3, L4).



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Anatomy: Hip and Thigh



Question 72 of 106

A 65 year old man presents with weakness in the right hip, most marked on flexion. You consider the possibility of a psoas major pathology. The psoas major muscle is innervated by which of the following nerves:

a Femoral nerve

b Obturator nerve

c Anterior rami of spinal nerves L1 – L3

d Pudendal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 72 of 106

A 65 year old man presents with weakness in the right hip, most marked on flexion. You consider the possibility of a psoas major pathology. The psoas major muscle is innervated by which of the following nerves:

a) Femoral nerve
b) Obturator nerve
c) **Anterior rami of spinal nerves L1 – L3** ✔
d) Pudendal nerve
e) Inferior gluteal nerve

Answer

The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

Notes

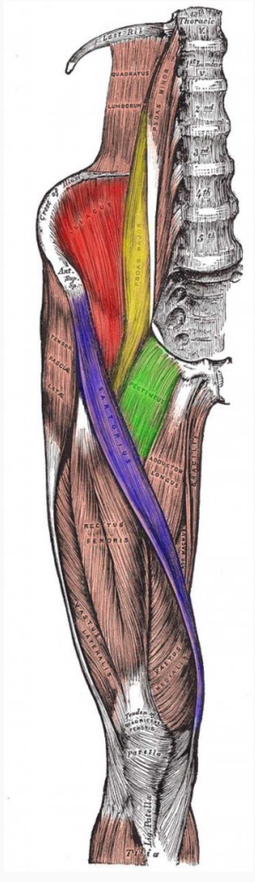
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 73 of 106

A 76 year old woman present to the ED after feeling in a "pop" in her right hip. She recently underwent a right total hip replacement, you suspect the hip is now dislocated. Regarding the extracapsular ligaments of the hip, which one of the following statements is INCORRECT:

a The iliofemoral ligament is the strongest of the extracapsular ligaments.

b There are three main extracapsular ligaments stabilising the hip joint.

c The pubofemoral ligament is anteroinferior to the hip joint.

d The ischiofemoral ligament is anterosuperior to the hip joint.

e The extracapsular ligaments all act to prevent excessive extension of the hip joint.

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Anatomy: Hip and Thigh

Question 73 of 106

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a) The iliofemoral ligament is the strongest of the extracapsular ligaments.
b) There are three main extracapsular ligaments stabilising the hip joint.
c) The pubofemoral ligament is anteroinferior to the hip joint.
d) **The ischiofemoral ligament is anterosuperior to the hip joint.** ✔
e) The extracapsular ligaments all act to prevent excessive extension of the hip joint.

Answer

There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament. The iliofemoral ligament is anterosuperior to the hip joint and specifically prevents hyperextension and lateral rotation of the hip joint whilst standing. The pubofemoral ligament is anteroinferior to the hip joint and acts to prevent excessive extension and abduction of the hip joint. The ischiofemoral ligament is posterior to the hip joint and acts to prevent excessive extension and medial rotation of the hip joint.

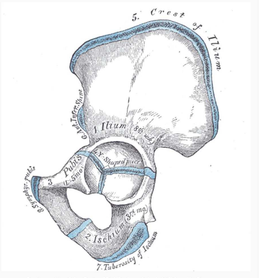
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

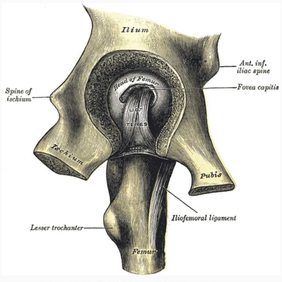


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

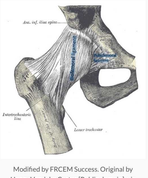
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 74 of 106

You are asked to review a 54 year old man who presents complaining of lower back pain with radiation down the right leg. You are concerned about sciatic nerve root compression. The sciatic nerve receives nerve fibres from which of the following nerve roots:

a L5 – S2

b L4 – S2

c L4 – S3

d L4 – S1

e L3 – S2

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Anatomy: Hip and Thigh

Question 74 of 106

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a) L5 – S2
b) L4 – S2
c) **L4 – S3** ✔
d) L4 – S1
e) L3 – S2

Answer

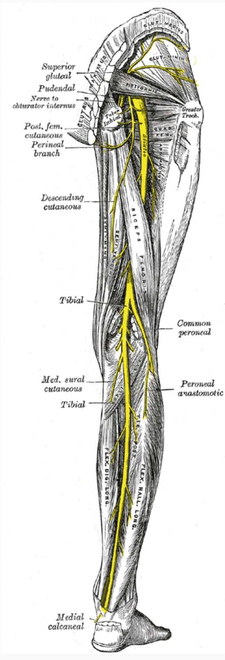
The sciatic nerve is derived from the lumbosacral plexus and receives fibres from L4 – S3.

Notes

The sciatic nerve is derived from the lumbosacral plexus and receives fibres from L4 – S3.

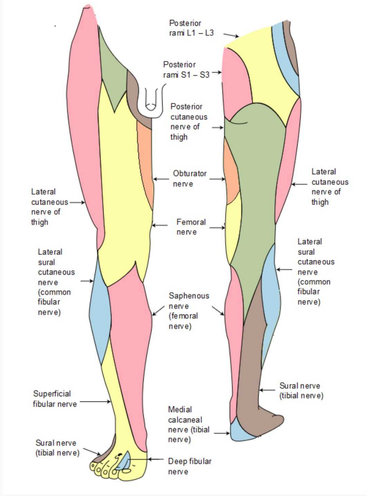
Nerve	Sciatic nerve
Nerve roots	L4 – S3
Motor supply	Posterior thigh muscles, hamstring portion of adductor magnus, all of the muscles in the leg and foot
Sensory supply	Skin on the lateral leg and foot, the heel and the dorsum and sole of the foot
Motor loss in injury	Weak extension of hip and flexion of knee, loss of dorsiflexion and plantarflexion of ankle, loss of inversion and eversion of foot, foot drop with high-stepping gait

The sciatic nerve leaves the pelvis and enters the gluteal region via the greater sciatic foramen inferior to the piriformis muscle before descending through the gluteal region and entering the posterior thigh. In the posterior compartment of the thigh, the sciatic nerve lies on the adductor magnus muscle and is crossed by the long head of the biceps femoris muscle. The sciatic nerve terminates at the apex of the popliteal fossa by dividing into the tibial (anterior divisions of L4 – S3) and the common fibular (posterior divisions of L4 – S2) nerves.



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Through its branches, the sciatic nerve innervates all of the muscles in the posterior compartment of the thigh, the hamstring portion of the adductor magnus, all of the muscles in the leg and the foot, and skin on the lateral leg and foot, the heel and the dorsum and sole of the foot.



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Clinical implications

The gluteal region can be divided into quadrants by 2 lines: one line descending vertically from the highest point of the iliac crest, the other line passing horizontally through the first line midway between the highest point of the iliac crest and the ischial tuberosity. The sciatic nerve passes through the lower medial quadrant. Intramuscular injections in the buttocks should always be given in the upper lateral quadrant of the gluteal region to avoid damage to the sciatic nerve and major vessels in the region.

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Anatomy: Hip and Thigh



Question 75 of 106

A 65 year old man comes to the ED with complaints of long-standing altered and burning sensation in the region of his thigh shown in the picture below. Which of the following nerves is most likely affected:



Image by FRCEM Success.

a Lateral cutaneous nerve of the sacral plexus

b Posterior cutaneous nerve of the lumbar plexus

c Posterior cutaneous nerve of the sacral plexus

d Lateral femoral cutaneous nerve

e Obturator nerve

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Anatomy: Hip and Thigh

Question 75 of 106

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Image by FRCEM Success.

a) **Lateral cutaneous nerve of the sacral plexus** ✖
b) Posterior cutaneous nerve of the lumbar plexus
c) Posterior cutaneous nerve of the sacral plexus
d) Lateral femoral cutaneous nerve ✔
e) Obturator nerve

Answer

The lateral cutaneous nerve of the thigh (lateral femoral cutaneous nerve), nerve from the lumbar plexus, supplies skin over the lateral thigh.

Notes

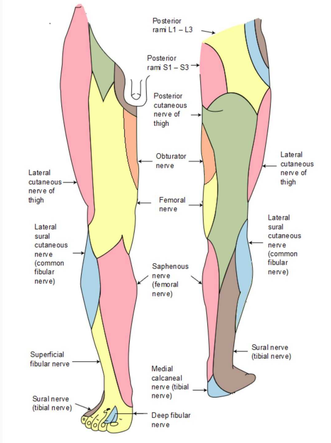
Nerve	Origin	Skin supplied
Lateral cutaneous nerve of thigh	Lumbar plexus (L2, L3)	Lateral thigh
Anterior cutaneous nerve	Femoral nerve	Anterior thigh and anteromedial knee
Cutaneous branch	Obturator nerve	Medial thigh
Posterior cutaneous nerve of thigh	Sacral plexus (S1 – S3)	Posterior thigh and upper leg
Saphenous nerve	Femoral nerve	Anteromedial knee, medial leg and foot
Lateral sural cutaneous nerve	Common fibular nerve	Upper lateral leg
Superficial fibular nerve	Common fibular nerve	Lower anterolateral leg and dorsum of foot
Deep fibular nerve	Common fibular nerve	Webspace between 1st and 2nd toe
Sural nerve	Tibial nerve	Lower posterolateral leg, heel and foot
Medial calcaneal nerve	Tibial nerve	Medial side and sole of heel
Medial and lateral plantar nerves	Tibial nerve	Sole of foot anterior to heel

Thigh:

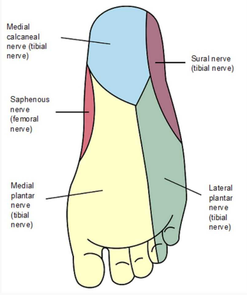
- The skin over the hip and gluteal region is supplied by the posterior and anterior rami of lumbosacral nerves (L1 – S3).
- The lateral cutaneous nerve of the thigh, nerve from the lumbar plexus, supplies skin over the lateral thigh.
- The anterior cutaneous nerve, branch of the femoral nerve, supplies skin over the anterior thigh and anteromedial knee.
- The obturator nerve supplies skin over the upper medial thigh.
- The posterior cutaneous nerve of the thigh, nerve from the sacral plexus, supplies skin over the posterior thigh and upper leg.

Leg:

- The saphenous nerve, branch of the femoral nerve, supplies the skin over the anteromedial knee, medial leg and the medial side of the foot as far anteriorly as the head of the 1st metatarsal.
- The lateral sural nerve, branch of the common fibular nerve, supplies the skin over the upper lateral leg.
- The superficial fibular nerve supplies the area of skin over the lower anterolateral leg and the dorsum of the foot (except for the webspace between the 1st and 2nd toe and the lateral side of the little toe).
- The deep fibular nerve supplies the skin over the webspace between the 1st and 2nd toe.
- The sural nerve, branch of the tibial nerve, supplies the skin over the lower posterolateral leg, heel and foot.
- The medial calcaneal nerve, branch of the tibial nerve, supplies the skin over the medial side and sole of the heel.
- The medial and lateral plantar nerves, branches of the tibial nerve, supply the skin over the sole of the foot anterior of the heel.



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Anatomy: Hip and Thigh



Question 76 of 106

You form part of the trauma team caring for a roofer who fell approximately 7 metres from a roof, landing across a beam. Imaging of the spine has revealed traumatic injuries to multiple lumbar vertebrae. The femoral nerve receives nerve fibres from which of the following nerve roots:

a L1, L2

b L1 – L4

c L1 – L3

d L2 – L4

e L3, L4

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Anatomy: Hip and Thigh

Question 76 of 106

You form part of the trauma team caring for a roofer who fell approximately 7 metres from a roof, landing across a beam. Imaging of the spine has revealed traumatic injuries to multiple lumbar vertebrae. The femoral nerve receives nerve fibres from which of the following nerve roots:

a) L1, L2
b) L1 – L4
c) L1 – L3
d) **L2 – L4** ✔
e) L3, L4

Answer

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

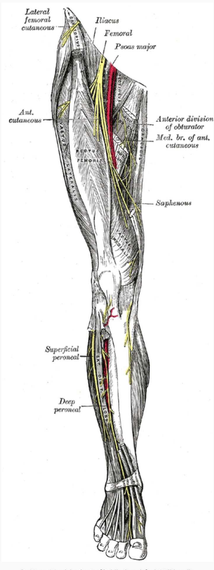
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

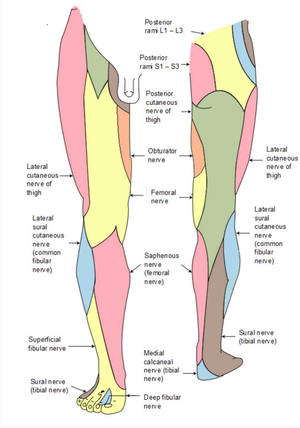
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Question 77 of 106

Your Consultant is discussing a case she saw earlier today. A 34 year old carpet fitter presented with pain on certain movements of the right leg. She diagnosed a sartorius muscle strain. Which of the following movements is he likely to have found painful:

a Flexion of the hip and flexion of the knee

b Flexion of the hip and extension of the knee

c Extension of the hip and flexion of the knee

d Flexion and medial rotation of the hip

e Extension of the hip and extension of the knee

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a) Flexion of the hip and flexion of the knee ✔
b) **Flexion of the hip and extension of the knee** ✖
c) Extension of the hip and flexion of the knee
d) Flexion and medial rotation of the hip
e) Extension of the hip and extension of the knee

Answer

The sartorius acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

Notes

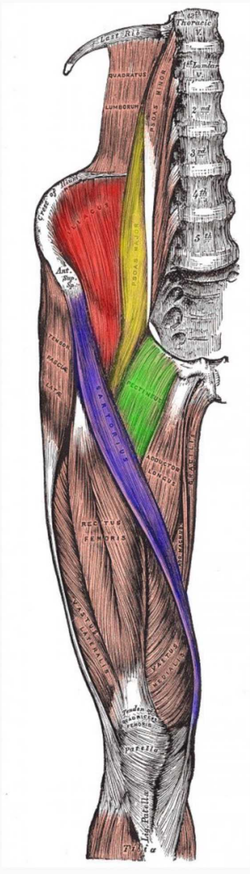
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 78 of 106

You have been asked to give a teaching session to a group of medical students regarding the anatomy of the hip and gluteal region. As part of the session you cover the innervation of the muscles of that region. The gluteus maximus muscle is innervated by which of the following nerves:

a Superior gluteal nerve

b Inferior gluteal nerve

c Femoral nerve

d Obturator nerve

e Sciatic nerve

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a) Superior gluteal nerve
b) **Inferior gluteal nerve** ✔
c) Femoral nerve
d) Obturator nerve
e) Sciatic nerve

Answer

The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

Notes

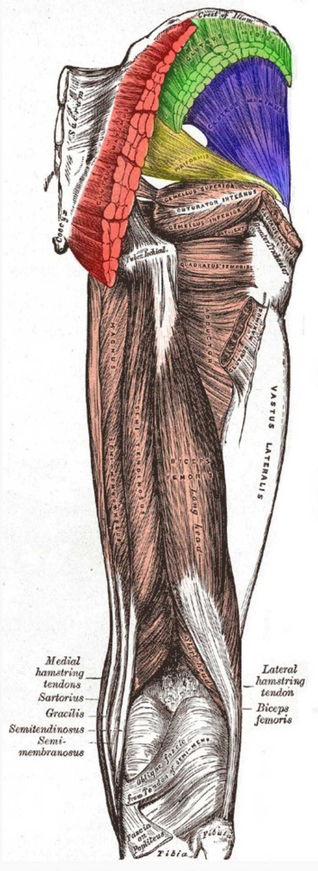
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 79 of 106

A 45 year old tree surgeon is brought into the ED following a fall from approximately 5 metres. A full trauma primary survey has been performed – the trauma team leader is concerned about a possible lumbar injury with resultant neurology. You have been asked to assess the sensation in the lower limb dermatomes. The L2 dermatome is best tested at which of the following landmarks:

a At the midpoint of the inguinal ligament in the midclavicular line

b At a point on the mid anterior thigh

c At a point on the posterolateral thigh

d At the medial femoral condyle

e At the popliteal fossa

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a) At the midpoint of the inguinal ligament in the midclavicular line
b) **At a point on the mid anterior thigh** ✔
c) At a point on the posterolateral thigh
d) At the medial femoral condyle
e) At the popliteal fossa

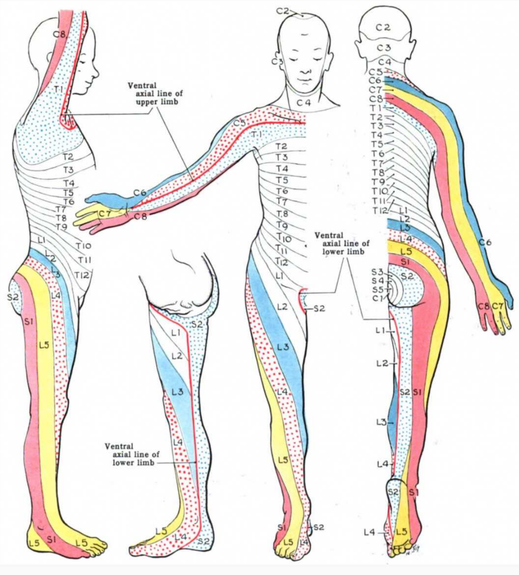
Answer

The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.

Notes

Dermatome	Landmark
L1	Upper Anterior Thigh
L2	Mid Anterior Thigh
L3	Medial Femoral Condyle
L4	Medial Malleolus
L5	Dorsum 3rd MTP Joint
S1	Lateral Heel
S2	Popliteal Fossa
S3	Ischial Tuberosity
S5	Perianal Area

- The T12 dermatome is best tested at the midclavicular line, over the midpoint of the inguinal ligament.
- The L1 dermatome is best tested on the upper anterior thigh, at a point midway between the key sensory points for T12 and L2.
- The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.
- The L3 dermatome is best tested at the medial femoral condyle above the knee.
- The L4 dermatome is best tested over the medial malleolus.
- The L5 dermatome is best tested on the dorsum of the foot at the third metatarsophalangeal joint.
- The S1 dermatome is best tested on the lateral aspect of the calcaneus.
- The S2 dermatome is best tested at the midpoint of the popliteal fossa.
- The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).
- The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.



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Anatomy: Hip and Thigh



Question 80 of 106

A 32 year old woman is brought to the ED after falling from a horse. Imaging shows multiple injuries to the pelvic region including transection of the nerve that supplies the piriformis muscle. Which of the following nerves has been transected:

a Obturator nerve

b Superior gluteal nerve

c Inferior gluteal nerve

d Nerve to the piriformis, branch of the sacral plexus

e Sciatic nerve

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a) Obturator nerve
b) Superior gluteal nerve
c) Inferior gluteal nerve
d) **Nerve to the piriformis, branch of the sacral plexus** ✔
e) Sciatic nerve

Answer

The piriformis is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2).

Notes

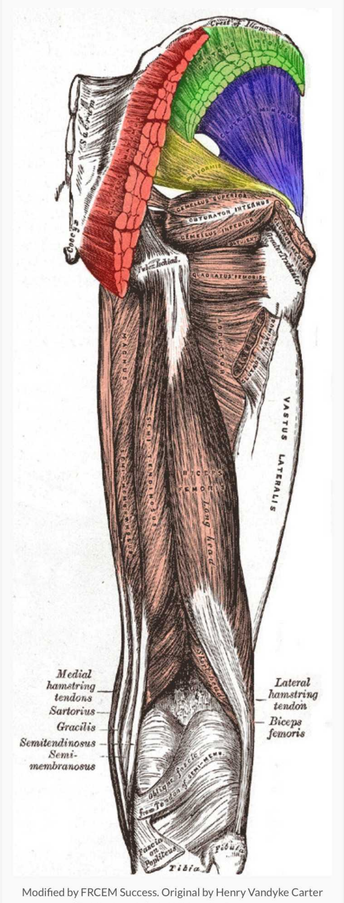
Muscle	Action(s)	Innervation
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Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

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Question 81 of 106

A 32 year old builder is brought to the ED after falling through a glass sky light onto the floor below. A primary survey has been performed and the patient is stable enough to undergo imaging. Imaging shows multiple injuries including a transection of the nerve supplying the adductor longus, magnus and brevis muscles. Which of the following movements is the patient likely to find difficult:

a Adduction and lateral rotation of the thigh

b Adduction and medial rotation of the thigh

c Abduction and flexion of the thigh

d Adduction and extension of the thigh

e Adduction and abduction of the thigh

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a) Adduction and lateral rotation of the thigh
b) **Adduction and medial rotation of the thigh** ✔
c) Abduction and flexion of the thigh
d) Adduction and extension of the thigh
e) Adduction and abduction of the thigh

Answer

The adductor longus (red), brevis (green) and magnus (blue) are the prime adductors of the thigh at the hip joint and also assist in medial rotation.

Notes

There are six muscles in the medial compartment of the thigh: the gracilis, the pectineus, the adductor longus, brevis and magnus and the obturator externus. Other than the obturator externus, these muscles all act to adduct the thigh at the hip joint.

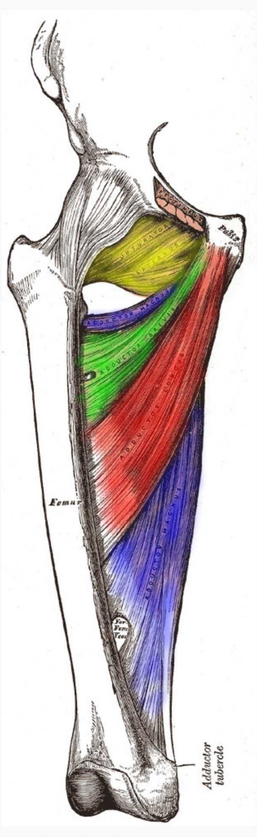
Testing of the medial thigh muscles can be performed with the patient lying supine and the knee straight. The patient is asked to adduct the thigh against resistance and the strength assessed (if the adductors are normal the proximal ends of the gracilis and adductor longus can easily be palpated).

Muscle	Action(s)	Innervation
Adductor longus (red)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4)
Adductor brevis (green)	Adduction and medial rotation at hip	Obturator nerve (L2, L3)
Adductor magnus (blue)	Adduction and medial rotation at hip	Obturator nerve (L2 – L4), tibial nerve (L4 – S3)
Obturator externus (yellow)	Lateral rotation at hip	Obturator nerve (L3, L4)
Gracilis	Adduction at hip and flexion at knee	Obturator nerve (L2, L3)
Pectineus	Adduction and flexion at hip	Femoral nerve (L2, L3)

The adductor longus (red), brevis (green) and magnus (blue) are the prime adductors of the thigh at the hip joint and also assist in medial rotation.

The adductor muscles are innervated by the obturator nerve (L2 – L4), except for the hamstrings portion of the adductor magnus innervated by the tibial nerve (L4 – S3).

The obturator externus muscle (yellow) acts to laterally rotate the thigh at the hip joint. It is innervated by the obturator nerve (L3, L4).



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Anatomy: Hip and Thigh



Question 82 of 106

You are discussing clinically relevant lower limb anatomy with a group of medical students. The femoral triangle is an important, clinically relevant concept. The femoral triangle is bordered superiorly by which of the following structures:

a Femoral sheath

b Inguinal ligament

c Femoral canal

d Femoral artery

e Pubic bone

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Anatomy: Hip and Thigh

Question 82 of 106

You are discussing clinically relevant lower limb anatomy with a group of medical students. The femoral triangle is an important, clinically relevant concept. The femoral triangle is bordered superiorly by which of the following structures:

a) Femoral sheath
b) **Inguinal ligament** ✔
c) Femoral canal
d) Femoral artery
e) Pubic bone

Answer

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

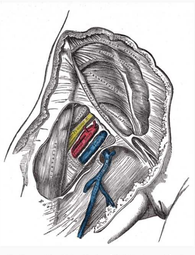
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The femoral triangle contains (from lateral to medial):

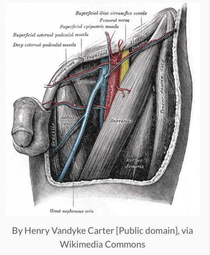
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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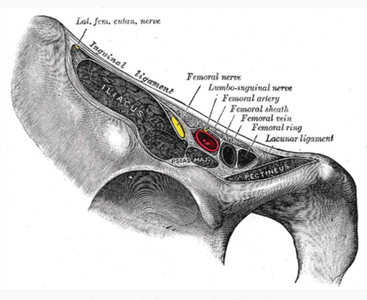
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 83 of 106

A 23 year old woman is brought to the Emergency Department after falling from a ride at an amusement park. Imaging has shown trauma to the sartorius, iliopsoas and pectineus muscles. These muscles all act together to produce which of the following movements:

a Extension at knee

b Adduction at hip

c Abduction at hip

d Extension at hip

e Flexion at hip

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Anatomy: Hip and Thigh

Question 83 of 106

A 23 year old woman is brought to the Emergency Department after falling from a ride at an amusement park. Imaging has shown trauma to the sartorius, iliopsoas and pectineus muscles. These muscles all act together to produce which of the following movements:

a) Extension at knee
b) Adduction at hip
c) Abduction at hip
d) Extension at hip
e) **Flexion at hip** ✔

Answer

The sartorius, iliopsoas and pectineus muscles are all flexors of the thigh at the hip joint.

Notes

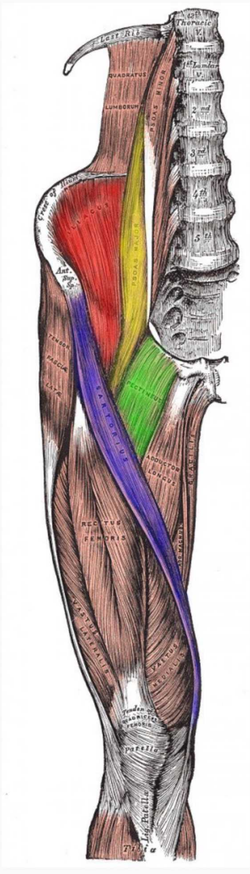
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 84 of 106

A 32 year old man presents to the ED after sustaining multiple stab wounds to the right thigh during an altercation in a pub. Imaging has shown trauma to the biceps femoris muscle. The biceps femoris acts primarily to produce which of the following movements at the hip:

a Extension and medial rotation at hip

b Extension and lateral rotation at hip

c Extension and abduction at hip

d Extension and adduction at hip

e Flexion and medial rotation at hip

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Anatomy: Hip and Thigh

Question 84 of 106

A 32 year old man presents to the ED after sustaining multiple stab wounds to the right thigh during an altercation in a pub. Imaging has shown trauma to the biceps femoris muscle. The biceps femoris acts primarily to produce which of the following movements at the hip:

a) Extension and medial rotation at hip
b) **Extension and lateral rotation at hip** ✔
c) Extension and abduction at hip
d) Extension and adduction at hip
e) Flexion and medial rotation at hip

Answer

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

Notes

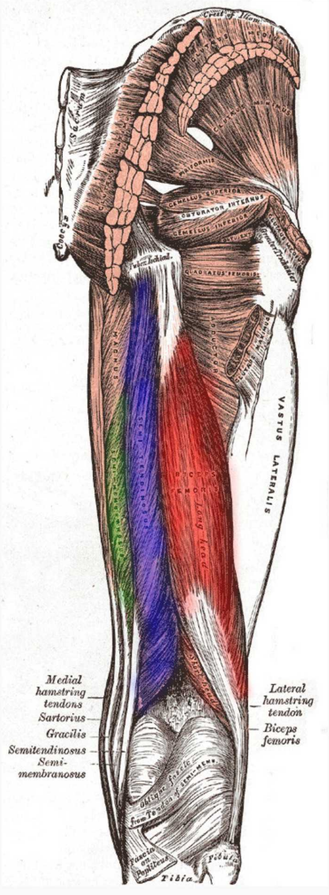
Muscle	Action(s)	Innervation
Biceps femoris (red)	Flexion at knee, extension and lateral rotation at hip	Sciatic nerve (L5 – S2)
Semitendinosus (blue)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)
Semimembranosus (green)	Flexion at knee, extension and medial rotation at hip	Sciatic nerve (L5 – S2)

The hamstrings are composed of three individual muscles; the biceps femoris (red), the semitendinosus (blue) and the semimembranosus (green).

The hamstrings act together to flex the leg at the knee joint and extend the thigh at the hip joint. The biceps femoris also acts to laterally rotate the thigh at the hip joint and the leg at the knee joint. The semimembranosus and semitendinosus also act together to medially rotate the thigh at the hip joint and the leg at the knee joint.

The hamstring muscles are all innervated by the tibial division of the sciatic nerve (L5 – S2), except for the short head of the biceps femoris innervated by the common fibular division.

To test the hamstrings the patient flexes their leg against resistance. Normally these muscles, especially their tendons on each side of the popliteal fossa, are prominent as they bend the knee.



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Anatomy: Hip and Thigh



Question 85 of 106

A 28 year old man is brought into ED following a motorcyle accident where his left lower limb was caught beneath the bike, and stabilised in the department. Later he is examined, and is noted to demonstrate a waddling gait. When asked to stand with his weight supported by just his left lower limb, the left side of his pelvis sags. Which of the following nerves has most likely been damaged:

a Femoral nerve

b Sciatic nerve

c Superior gluteal nerve

d Inferior gluteal nerve

e Obturator nerve

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Anatomy: Hip and Thigh

Question 85 of 106

A 28 year old man is brought into ED following a motorcycle accident where his left lower limb was caught beneath the bike, and stabilised in the department. Later he is examined, and is noted to demonstrate a waddling gait. When asked to stand with his weight supported by just his left lower limb, the left side of his pelvis sags. Which of the following nerves has most likely been damaged:

a) Femoral nerve
b) Sciatic nerve
c) **Superior gluteal nerve** ✔
d) Inferior gluteal nerve
e) Obturator nerve

Answer

The patient demonstrates Trendelenburg's sign which is seen in patients with weakened or paralysed abductor muscles – primarily the gluteus medius and gluteus minimus, which are innervated by the superior gluteal nerve.

Notes

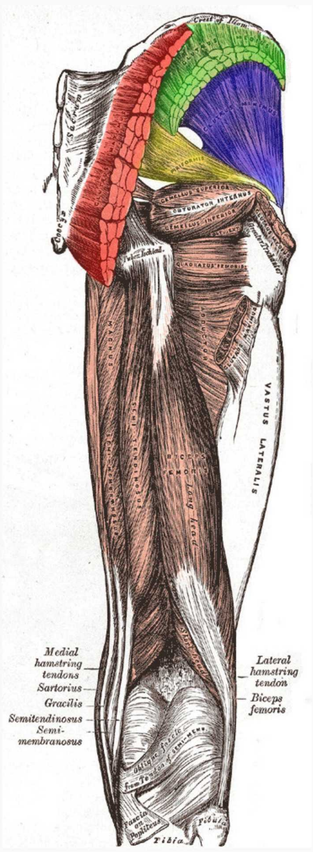
Muscle	Action(s)	Innervation
Gluteus maximus (red)	Extension, lateral rotation and abduction at hip	Inferior gluteal nerve (L5 – S2)
Gluteus medius (green)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Gluteus minimus (blue)	Abduction and medial rotation at hip	Superior gluteal nerve (L4 – S1)
Piriformis (yellow)	Lateral rotation and abduction at hip	Branches from S1 and S2

The gluteus maximus (red) is the main extensor of the thigh at the hip joint and also acts to laterally rotate and abduct the thigh. Through its insertion into the iliotibial tract, it also stabilises the knee and hip joints. The gluteus maximus is innervated by the inferior gluteal nerve (L5 – S2).

The gluteus medius (green) and gluteus minimus (blue) act to abduct and medially rotate the thigh at the hip joint, and also act to secure the pelvis, reducing pelvic drop on the opposite swing side during walking. They are both innervated by the superior gluteal nerve (L4 – S1).

The piriformis (yellow) acts to abduct and laterally rotate the thigh at the hip joint. It is innervated by the nerve to the piriformis, originating from the sacral plexus (S1, S2). The obturator internus, gemelli and quadriceps femoris muscles act as synergistic femoral lateral rotators and hip stabilisers.

Trendelenburg's sign is seen in people with weak/paralysed abductor muscles of the hip. The sign is demonstrated by asking the patient to stand on one limb; when the patient stands on the affected limb, the pelvis severely drops over the swing limb. This sign may be seen in patients with damage to the superior gluteal nerve, which may occur in association with pelvic fractures, with space-occupying lesions within the pelvis extending into the greater sciatic foramen, and following hip surgery. Typically the patient may also demonstrate a Trendelenburg gait.



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Anatomy: Hip and Thigh



Question 86 of 106

A 32 year old man presents to the ED after falling through a glass door. He has sustained a deep laceration to the thigh. Imaging shows a source of bleeding in the medial thigh. The medial thigh receives its blood supply primarily from which of the following arteries:

a Superior gluteal artery and obturator artery

b Profunda femoris artery and obturator artery

c Medial circumflex artery and obturator artery

d Inferior gluteal artery and medial circumflex artery

e Superior and inferior gluteal arteries

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Anatomy: Hip and Thigh

Question 86 of 106

A 32 year old man presents to the ED after falling through a glass door. He has sustained a deep laceration to the thigh. Imaging shows a source of bleeding in the medial thigh. The medial thigh receives its blood supply primarily from which of the following arteries:

a) Superior gluteal artery and obturator artery
b) **Profunda femoris artery and obturator artery** ✔
c) Medial circumflex artery and obturator artery
d) Inferior gluteal artery and medial circumflex artery
e) Superior and inferior gluteal arteries

Answer

The profunda femoris is the primary artery of the medial thigh, assisted by the obturator artery.

Notes

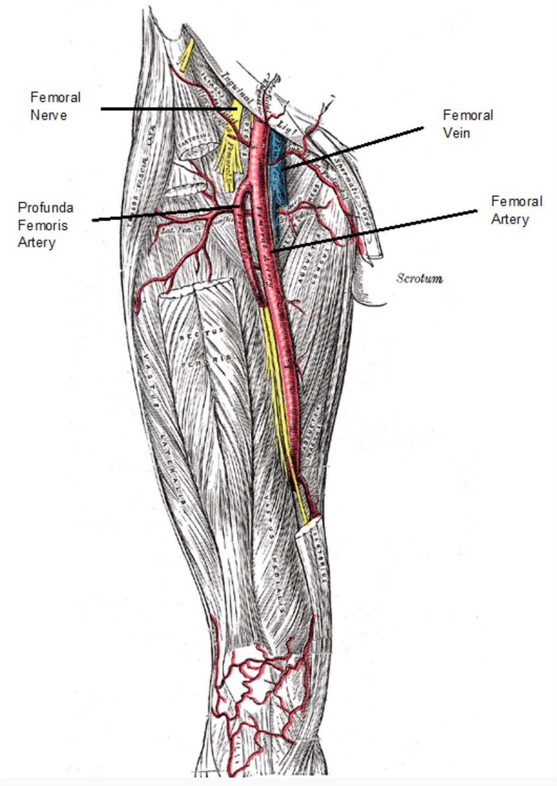
The major artery supplying the lower limb is the femoral artery. The femoral artery is the continuation of the external iliac artery, beginning as the vessel passes under the inguinal ligament to enter the femoral triangle in the anterior thigh.

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). The femoral vein lies immediately medial to this pulsation, which is an important landmark for central venous line insertion. Medial to the femoral vein is the femoral canal which contains lymphatics and lies immediately lateral to the pubic tubercle. The femoral nerve lies lateral to the femoral artery.

The femoral artery gives rise to the deep profunda femoris artery in the femoral triangle which is a major source of blood supply to the medial and posterior compartments of the thigh and the proximal femur.

After exiting the femoral triangle, the femoral artery continues down the anterior surface of the thigh via the adductor canal. During its descent it supplies the anterior thigh, giving rise to numerous superficial cutaneous branches.

The femoral artery becomes the popliteal artery after entering the posterior compartment of the thigh through the adductor hiatus just proximal to the knee.



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Anatomy: Hip and Thigh



Question 87 of 106

You are part of the team in the resuscitation area. You have been pre-alerted to the arrival of a 35 year old man who has had a cardiac arrest at a football match. On arrival the team leader asks you to perform a femoral pulse check. At which of the following sites is the femoral artery best palpated:

a Inferior to the inguinal ligament, just medial to the femoral vein

b Inferior to the inguinal ligament, just medial to the femoral canal

c Just inferior to the inguinal ligament at the mid-inguinal point

d In the femoral triangle, just superior to the inguinal ligament

e At the mid-inguinal point just lateral to the femoral nerve

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Question 87 of 106

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a) Inferior to the inguinal ligament, just medial to the femoral vein
b) Inferior to the inguinal ligament, just medial to the femoral canal
c) **Just inferior to the inguinal ligament at the mid-inguinal point** ✔
d) In the femoral triangle, just superior to the inguinal ligament
e) At the mid-inguinal point just lateral to the femoral nerve

Answer

The femoral artery can be palpated in the femoral triangle as it passes over the femoral head, just inferior to the inguinal ligament, midway between the anterior superior iliac spine and the pubic symphysis (at the mid-inguinal point). Remember NAVY (from lateral to medial): femoral Nerve, femoral Artery, femoral Vein, Y-fronts (i.e. the midline).

Notes

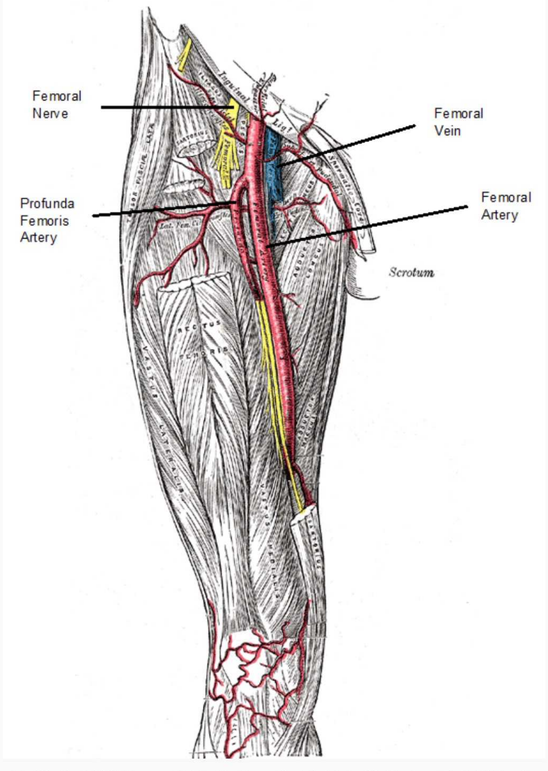
The major artery supplying the lower limb is the femoral artery. The femoral artery is the continuation of the external iliac artery, beginning as the vessel passes under the inguinal ligament to enter the femoral triangle in the anterior thigh.

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Anatomy: Hip and Thigh



Question 88 of 106

A 27 year old footballer presents with pain on flexion and lateral rotation of the hip and flexion of the knee. You suspect a sartorius muscle pathology. The sartorius muscle is innervated by which of the following nerves:

a Femoral nerve

b Obturator nerve

c Sciatic nerve

d Pudendal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 88 of 106

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a) Femoral nerve ✔
b) Obturator nerve
c) Sciatic nerve
d) Pudendal nerve
e) Inferior gluteal nerve

Answer

The sartorius is innervated by the femoral nerve (L2, L3).

Notes

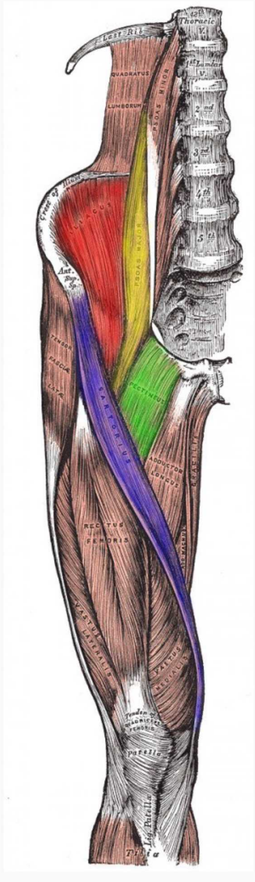
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 89 of 106

You are examining a 65 year old man who presents with left leg weakness. You note a loss of power to the left quadriceps femoris muscles. The quadriceps femoris muscles are innervated by which of the following nerves:

a Sciatic nerve

b Pudendal nerve

c Femoral nerve

d Obturator nerve

e Superior gluteal nerve

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a) Sciatic nerve
b) Pudendal nerve
c) **Femoral nerve** ✔
d) Obturator nerve
e) Superior gluteal nerve

Answer

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4).

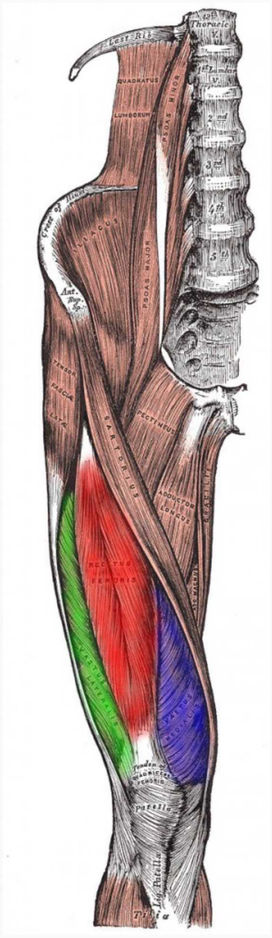
Notes

Muscle	Action(s)	Innervation
Rectus femoris (red)	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)
Vastus lateralis (green)	Extension at knee	Femoral nerve (L2 – L4)
Vastus medialis (blue)	Extension at knee	Femoral nerve (L2 – L4)
Vastus intermedius	Extension at knee	Femoral nerve (L2 – L4)

The quadriceps femoris is made up of four individual muscles; the rectus femoris (red), the vastus medialis (blue), the vastus intermedius (deep to the rectus femoris) and the vastus lateralis (green) which all insert onto the patella by the common quadriceps femoris tendon. Because the vastus muscles insert into the margins of the patella as well as into the quadriceps femoris tendon, they stabilise the position of the patella during knee joint movement.

The quadriceps femoris muscle is the main extensor of the leg at the knee joint. The rectus femoris crosses both the knee and the hip joint (in contrast to the vastus muscles which only cross the knee joint), and therefore also assists in flexion of the thigh at the hip joint.

The quadriceps femoris muscles are innervated by the femoral nerve (L2 – L4). A tap on the patella ligament tests reflex activity mainly at spinal cord levels L3/L4.



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Anatomy: Hip and Thigh



Question 90 of 106

You are examining a 38 year old woman who presents with lower back pain associated with bilateral sciatica. On examination you note loss of sensation in the L1 dermatome. You are concerned about a possible diagnosis of cauda equina. The L1 dermatome is best tested at which of the following landmarks:

a At the umbilicus in the midclavicular line

b At the midpoint of the inguinal ligament

c At a point on the posterolateral thigh

d At a point on the upper anterior thigh

e At the medial femoral condyle

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a) At the umbilicus in the midclavicular line
b) At the midpoint of the inguinal ligament
c) At a point on the posterolateral thigh
d) **At a point on the upper anterior thigh** ✔
e) At the medial femoral condyle

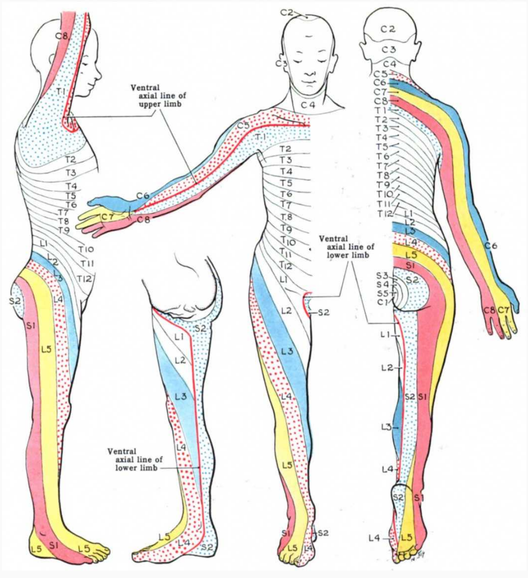
Answer

The L1 dermatome is best tested on the upper anterior thigh, midway between the key sensory points for T12 (midpoint of the inguinal ligament) and L2 (mid anterior thigh).

Notes

Dermatome	Landmark
L1	Upper Anterior Thigh
L2	Mid Anterior Thigh
L3	Medial Femoral Condyle
L4	Medial Malleolus
L5	Dorsum 3rd MTP Joint
S1	Lateral Heel
S2	Popliteal Fossa
S3	Ischial Tuberosity
S5	Perianal Area

- The T12 dermatome is best tested at the midclavicular line, over the midpoint of the inguinal ligament.
- The L1 dermatome is best tested on the upper anterior thigh, at a point midway between the key sensory points for T12 and L2.
- The L2 dermatome is best tested on the anteromedial thigh, at the midpoint drawn on an imaginary line connecting the midpoint of the inguinal ligament and the medial femoral condyle.
- The L3 dermatome is best tested at the medial femoral condyle above the knee.
- The L4 dermatome is best tested over the medial malleolus.
- The L5 dermatome is best tested on the dorsum of the foot at the third metatarsophalangeal joint.
- The S1 dermatome is best tested on the lateral aspect of the calcaneus.
- The S2 dermatome is best tested at the midpoint of the popliteal fossa.
- The S3 dermatome is best tested over the ischial tuberosity or infragluteal fold (depending on the patient their skin can move up, down or laterally over the ischii).
- The S4/S5 dermatome is best tested in the perianal area, less than one cm lateral to the mucocutaneous junction.



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Anatomy: Hip and Thigh



Question 91 of 106

A 54 year old woman is brought into the ED following a multiple vehicle collision on the nearby motorway. She is haemodynamically stable and the trauma team arrange imaging. Amongst other injuries she has transected the nerve that supplies the gracilis muscle. Which nerve has been damaged:

a Sciatic nerve

b Femoral nerve

c Obturator nerve

d Superior gluteal nerve

e Common fibular nerve

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a) Sciatic nerve
b) Femoral nerve
c) **Obturator nerve** ✔
d) Superior gluteal nerve
e) Common fibular nerve

Answer

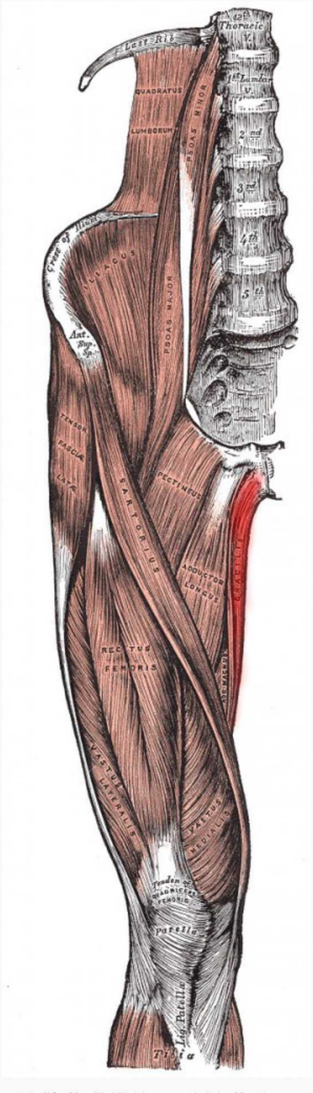
The gracilis is innervated by the obturator nerve (L2, L3).

Notes

The gracilis muscle is a muscle of the medial compartment of the thigh.

The gracilis acts to adduct the thigh at the hip joint and flex the leg at the knee joint.

It is innervated by the obturator nerve (L2, L3).



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Anatomy: Hip and Thigh



Question 92 of 106

A 67 year old man presents to the ED complaining of pain and swelling to the posterior knee. On examination you note a tender swelling in the popliteal fossa. The contents of the popliteal fossa include all of the following except for the:

a Popliteal artery

b Popliteal vein

c Tibial nerve

d Common fibular nerve

e Great saphenous vein

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Anatomy: Hip and Thigh

Question 92 of 106

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a) Popliteal artery
b) Popliteal vein
c) Tibial nerve
d) Common fibular nerve
e) **Great saphenous vein** ✔

Answer

The major structures contained within the popliteal fossa are the popliteal artery, the popliteal vein, the tibial nerve and the common fibular nerve.

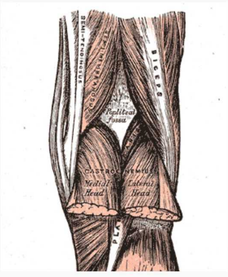
Notes

The popliteal fossa is a diamond-shaped space behind the knee joint.

Popliteal fossa	Structure(s)
Superomedial border	Semimembranosus
Superolateral border	Biceps femoris
Inferomedial border	Medial head of gastrocnemius
Inferolateral border	Lateral head of gastrocnemius and plantaris
Floor	Knee joint capsule and adjacent surfaces of femur and tibia and popliteus muscle
Roof	Deep fascia
Contents	Popliteal artery, popliteal vein, tibial nerve, common fibular nerve

The popliteal fossa is bordered:

- superomedially by the semimembranosus
- superolaterally by the biceps femoris
- inferomedially by the medial head of the gastrocnemius
- inferolaterally by the lateral head of the gastrocnemius and plantaris

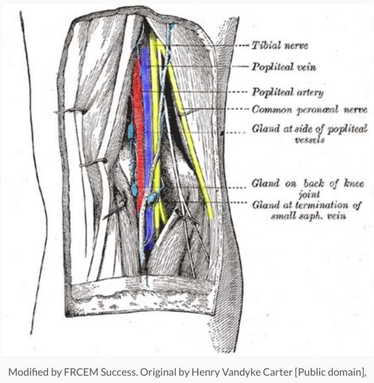


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The floor of the fossa is formed by the capsule of the knee joint and adjacent surfaces of the femur and tibia, and more inferiorly by the popliteus muscle. The roof is formed by deep fascia.

The major structures contained within the popliteal fossa are (from medial to lateral):

- the popliteal artery
- the popliteal vein
- the tibial nerve
- the common fibular nerve



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The small saphenous vein ascends in the superficial fascia on the back of the leg to the knee where it penetrates the deep fascia and enters the popliteal fossa to drain into the popliteal vein. One other structure that passes through the roof of the fossa is the posterior cutaneous nerve of the thigh which descends through the thigh superficial to the hamstring muscles, passes through the roof of the popliteal fossa, and then continues inferiorly with the small saphenous vein to supply skin on the upper half of the posterior leg.

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Anatomy: Hip and Thigh



Question 93 of 106

A 26 year old male has sustained a stab wound to the popliteal fossa and has injured the most lateral structure within this region. Which of the following structures has most likely been injured:

a Popliteal artery

b Tibial nerve

c Popliteal vein

d Common fibular nerve

e Saphenous vein

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Anatomy: Hip and Thigh



Question 93 of 106

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a) Popliteal artery
b) Tibial nerve
c) Popliteal vein
d) **Common fibular nerve** ✔
e) Saphenous vein

Answer

The major structures contained within the popliteal fossa are, from medial to lateral, the popliteal artery, the popliteal vein, the tibial nerve and the common fibular nerve. The saphenous vein does not pass through the popliteal fossa.

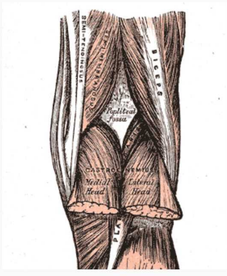
Notes

The popliteal fossa is a diamond-shaped space behind the knee joint.

Popliteal fossa	Structure(s)
Superomedial border	Semimembranosus
Superolateral border	Biceps femoris
Inferomedial border	Medial head of gastrocnemius
Inferolateral border	Lateral head of gastrocnemius and plantaris
Floor	Knee joint capsule and adjacent surfaces of femur and tibia and popliteus muscle
Roof	Deep fascia
Contents	Popliteal artery, popliteal vein, tibial nerve, common fibular nerve

The popliteal fossa is bordered:

- superomedially by the semimembranosus
- superolaterally by the biceps femoris
- inferomedially by the medial head of the gastrocnemius
- inferolaterally by the lateral head of the gastrocnemius and plantaris

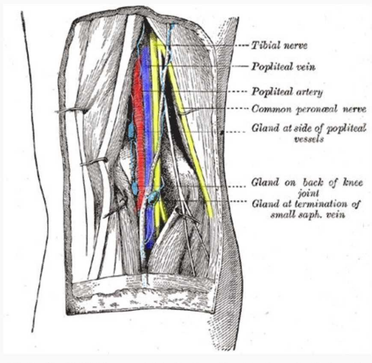


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The floor of the fossa is formed by the capsule of the knee joint and adjacent surfaces of the femur and tibia, and more inferiorly by the popliteus muscle. The roof is formed by deep fascia.

The major structures contained within the popliteal fossa are (from medial to lateral):

- the popliteal artery
- the popliteal vein
- the tibial nerve
- the common fibular nerve



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The small saphenous vein ascends in the superficial fascia on the back of the leg to the knee where it penetrates the deep fascia and enters the popliteal fossa to drain into the popliteal vein. One other structure that passes through the roof of the fossa is the posterior cutaneous nerve of the thigh which descends through the thigh superficial to the hamstring muscles, passes through the roof of the popliteal fossa, and then continues inferiorly with the small saphenous vein to supply skin on the upper half of the posterior leg.

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Anatomy: Hip and Thigh



Question 94 of 106

You form part of the trauma team caring for a roofer who fell approximately 7 metres from a roof, landing across a beam. Imaging of the spine has revealed traumatic injuries to multiple lumbar vertebrae and the femoral nerve. Given the cutaneous innervation of the femoral nerve which of the following areas would you expect altered sensation:

a Anterolateral thigh

b Anterolateral thigh, lateral leg and foot

c Medial leg and foot

d Anterior thigh, medial leg and foot

e Anteromedial thigh, lateral leg and foot

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Anatomy: Hip and Thigh

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a) Anterolateral thigh
b) Anterolateral thigh, lateral leg and foot
c) Medial leg and foot
d) **Anterior thigh, medial leg and foot** ✔
e) Anteromedial thigh, lateral leg and foot

Answer

The femoral nerve supplies skin over the anterior thigh and through its saphenous branch, skin over the anteromedial knee, the medial leg and the medial foot.

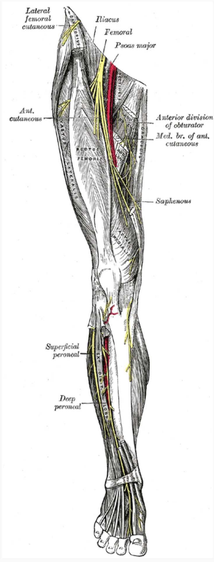
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

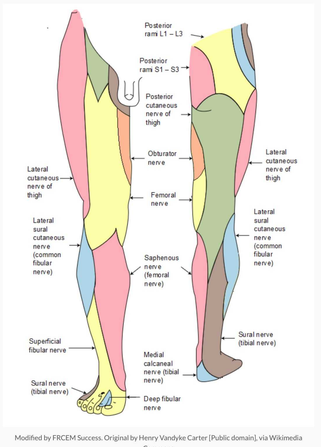
The anterior division gives off anterior cutaneous branches (supplying skin over the anterior and medial thigh) and muscular branches (innervating the sartorius).

The posterior division gives off muscular branches (innervating the quadriceps femoris muscles) and articular branches (supplying the hip and knee joint), before continuing as the saphenous nerve (supplying skin over the anteromedial knee and the medial side of the leg and foot).

Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
Anterior cutaneous branches	Skin over anterior thigh
Anterior muscular branches	Sartorius
Posterior muscular branches	Quadriceps femoris muscles
Posterior articular branches	Hip and knee joint
Saphenous nerve	Skin over anteromedial knee, medial side of leg and foot

Motor and sensory function

Muscle	Action(s)
Sartorius	Flexion, abduction and lateral rotation at hip and flexion at knee
Iliacus (red)	Flexion and lateral rotation at hip
Pectineus (green)	Adduction and flexion at hip
Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
Vastus intermedius	Extension at knee



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Anatomy: Hip and Thigh



Question 95 of 106

A 28 year old man was involved in a road traffic accident, and subsequently complained of weakness in extending his leg at the knee joint. Following examination, he was diagnosed with a lesion of his femoral nerve. Which of the following clinical findings would you most expect to see in this patient:

a Paralysis of the psoas major muscle

b Loss of sensation over the lateral thigh

c Paralysis of the rectus femoris muscle

d Loss of sensation over the lateral leg

e Paralysis of the gracilis muscle

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Anatomy: Hip and Thigh

Question 95 of 106

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a) Paralysis of the psoas major muscle
b) Loss of sensation over the lateral thigh
c) **Paralysis of the rectus femoris muscle** ✔
d) Loss of sensation over the lateral leg
e) Paralysis of the gracilis muscle

Answer

The femoral nerve innervates the iliacus, pectineus, sartorius and quadriceps femoris muscles, and supplies skin on the anterior thigh, anteromedial knee and medial leg.

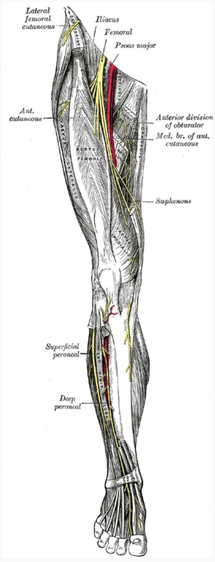
Notes

The femoral nerve arises from the lumbar plexus, receiving fibres from the anterior rami of L2 – L4.

Nerve	Femoral nerve
Nerve roots	L2 – L4
Motor supply	Iliacus, pectineus, sartorius, quadriceps femoris
Sensory supply	Skin over the anterior thigh, anteromedial knee, medial leg and medial foot
Motor loss in injury	Weak flexion at hip and loss of extension at knee

Anatomical course

The femoral nerve descends from the lumbar plexus in the posterior abdomen through the substance of the psoas major muscle, emerging from the lower lateral border of the psoas major. Continuing its descent, the femoral nerve lies between the lateral border of the psoas major and the anterior surface of the iliacus muscle. It is deep to the iliacus fascia and lateral to the femoral artery as it passes posterior to the mid-inguinal point to enter the femoral triangle in the anterior compartment of the thigh, before dividing into an anterior and posterior division.



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Branches

In the abdomen it gives rise to branches that innervate the iliacus and pectineus muscles.

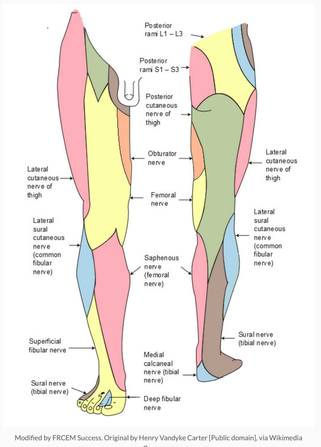
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Branch	Innervation
Muscular branches in abdomen	Iliacus and pectineus
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Motor and sensory function

Muscle	Action(s)
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Rectus femoris	Flexion at hip and extension at knee
Vastus lateralis	Extension at knee
Vastus medialis	Extension at knee
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Anatomy: Hip and Thigh



Question 96 of 106

A 28 year old man was involved in a motorbike accident where he sustained a crush injury to his pelvis and right leg and damaged a nerve innervating the lower limb. He is unable to extend the leg at the knee joint. Which of the following clinical findings might you also expect on examination:

a Weak extension of the thigh at the hip

b Weak dorsiflexion of the ankle

c Loss of sensation over the anterior thigh

d Trendelenburg's sign

e Loss of sensation over the lateral leg and foot

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a) Weak extension of the thigh at the hip
b) Weak dorsiflexion of the ankle
c) **Loss of sensation over the anterior thigh** ✔
d) Trendelenburg's sign
e) Loss of sensation over the lateral leg and foot

Answer

Extension of the leg at the knee joint is primarily produced by the quadriceps femoris muscle which is innervated by the femoral nerve. The femoral nerve also innervates the iliacus, pectineus and sartorius muscles which, together with the rectus femoris muscle (and the psoas major), are involved in flexion of the thigh at the hip. The femoral nerve also gives rise to cutaneous branches supplying skin on the anterior thigh and the saphenous nerve supplying skin over the medial leg at foot.

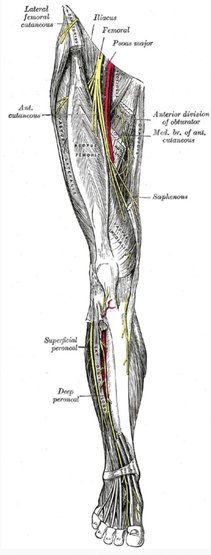
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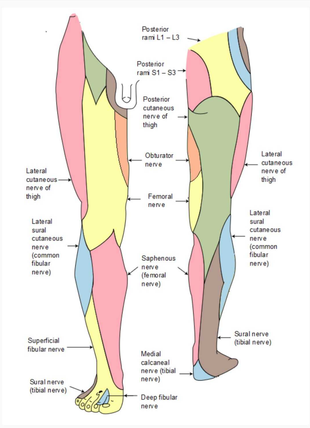
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Anatomy: Hip and Thigh



Question 97 of 106

A 65 year old man presents to the ED complaining of loss of sensation over the lateral thigh. This area is primarily supplied by which of the following nerves:

a The lateral cutaneous nerve of the thigh, branch of the femoral nerve

b The lateral cutaneous nerve of the thigh, branch of the obturator nerve

c The lateral cutaneous nerve of the thigh, branch of the sciatic nerve

d The lateral cutaneous nerve of the thigh from the lumbar plexus

e The lateral cutaneous nerve of the thigh from the sacral plexus

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Anatomy: Hip and Thigh

Question 97 of 106

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b) The lateral cutaneous nerve of the thigh, branch of the obturator nerve
c) The lateral cutaneous nerve of the thigh, branch of the sciatic nerve
d) **The lateral cutaneous nerve of the thigh from the lumbar plexus** ✔
e) The lateral cutaneous nerve of the thigh from the sacral plexus

Answer

The lateral cutaneous nerve of the thigh, nerve from the lumbar plexus, supplies skin over the lateral thigh.

Notes

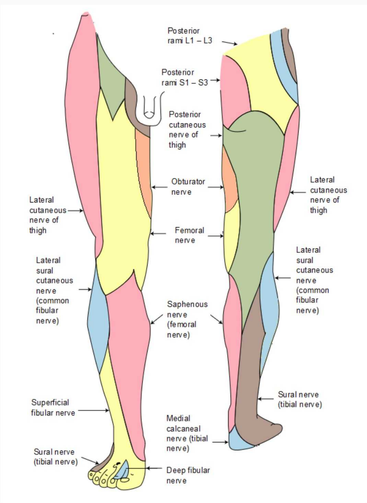
Nerve	Origin	Skin supplied
Lateral cutaneous nerve of thigh	Lumbar plexus (L2, L3)	Lateral thigh
Anterior cutaneous nerve	Femoral nerve	Anterior thigh and anteromedial knee
Cutaneous branch	Obturator nerve	Medial thigh
Posterior cutaneous nerve of thigh	Sacral plexus (S1 – S3)	Posterior thigh and upper leg
Saphenous nerve	Femoral nerve	Anteromedial knee, medial leg and foot
Lateral sural cutaneous nerve	Common fibular nerve	Upper lateral leg
Superficial fibular nerve	Common fibular nerve	Lower anterolateral leg and dorsum of foot
Deep fibular nerve	Common fibular nerve	Webspace between 1st and 2nd toe
Sural nerve	Tibial nerve	Lower posterolateral leg, heel and foot
Medial calcaneal nerve	Tibial nerve	Medial side and sole of heel
Medial and lateral plantar nerves	Tibial nerve	Sole of foot anterior to heel

Thigh:

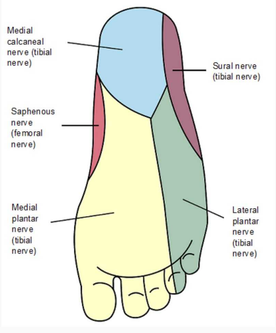
- The skin over the hip and gluteal region is supplied by the posterior and anterior rami of lumbosacral nerves (L1 – S3).
- The lateral cutaneous nerve of the thigh, nerve from the lumbar plexus, supplies skin over the lateral thigh.
- The anterior cutaneous nerve, branch of the femoral nerve, supplies skin over the anterior thigh and anteromedial knee.
- The obturator nerve supplies skin over the upper medial thigh.
- The posterior cutaneous nerve of the thigh, nerve from the sacral plexus, supplies skin over the posterior thigh and upper leg.

Leg:

- The saphenous nerve, branch of the femoral nerve, supplies the skin over the anteromedial knee, medial leg and the medial side of the foot as far anteriorly as the head of the 1st metatarsal.
- The lateral sural nerve, branch of the common fibular nerve, supplies the skin over the upper lateral leg.
- The superficial fibular nerve supplies the area of skin over the lower anterolateral leg and the dorsum of the foot (except for the webspace between the 1st and 2nd toe and the lateral side of the little toe).
- The deep fibular nerve supplies the skin over the webspace between the 1st and 2nd toe.
- The sural nerve, branch of the tibial nerve, supplies the skin over the lower posterolateral leg, heel and foot.
- The medial calcaneal nerve, branch of the tibial nerve, supplies the skin over the medial side and sole of the heel.
- The medial and lateral plantar nerves, branches of the tibial nerve, supply the skin over the sole of the foot anterior of the heel.



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Anatomy: Hip and Thigh



Question 98 of 106

A 65 year old lady is brought to ED after falling off a ladder. The acetabulum is fractured at its posterosuperior margin by dislocation of the hip joint. Which of the following bones is most likely to be involved:

a Ilium

b Ischium

c Pubis

d Sacrum

e Head of femur

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Anatomy: Hip and Thigh

Question 98 of 106

A 65 year old lady is brought to ED after falling off a ladder. The acetabulum is fractured at its posterosuperior margin by dislocation of the hip joint. Which of the following bones is most likely to be involved:

a) **Ilium** ✔
b) Ischium
c) Pubis
d) Sacrum
e) Head of femur

Answer

The acetabulum is formed by the fusion of the three bones, the ilium superiorly, the ischium posteroinferiorly and the pubis anteromedially.

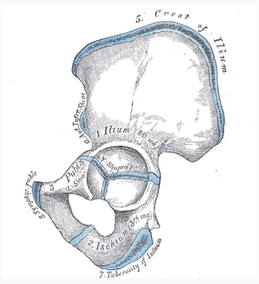
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

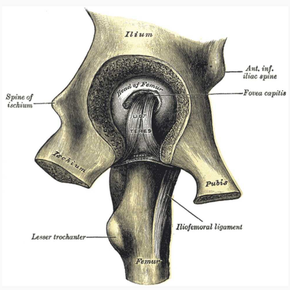


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

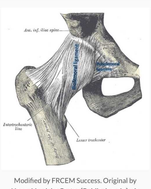
The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 99 of 106

A 54 year old man presents to the ED complaining of a numbness over over the posterior thigh. The skin in this area is primarily supplied by which of the following nerves:

a The posterior cutaneous nerve of the thigh, branch of the sciatic nerve

b The posterior cutaneous nerve of the thigh from the lumbar plexus

c The posterior cutaneous nerve of the thigh from the sacral plexus

d Posterior cutaneous branches from the femoral nerve

e Posterior cutaneous branches from the obturator nerve

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Anatomy: Hip and Thigh

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a) **The posterior cutaneous nerve of the thigh, branch of the sciatic nerve** ✖
b) The posterior cutaneous nerve of the thigh from the lumbar plexus
c) The posterior cutaneous nerve of the thigh from the sacral plexus ✔
d) Posterior cutaneous branches from the femoral nerve
e) Posterior cutaneous branches from the obturator nerve

Answer

The posterior cutaneous nerve of the thigh, nerve from the sacral plexus, supplies skin over the posterior thigh and upper leg.

Notes

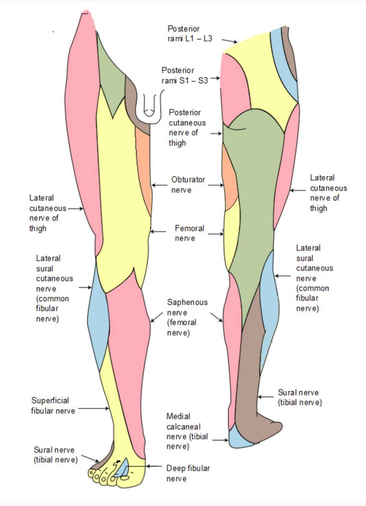
Nerve	Origin	Skin supplied
Lateral cutaneous nerve of thigh	Lumbar plexus (L2, L3)	Lateral thigh
Anterior cutaneous nerve	Femoral nerve	Anterior thigh and anteromedial knee
Cutaneous branch	Obturator nerve	Medial thigh
Posterior cutaneous nerve of thigh	Sacral plexus (S1 – S3)	Posterior thigh and upper leg
Saphenous nerve	Femoral nerve	Anteromedial knee, medial leg and foot
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Superficial fibular nerve	Common fibular nerve	Lower anterolateral leg and dorsum of foot
Deep fibular nerve	Common fibular nerve	Webspace between 1st and 2nd toe
Sural nerve	Tibial nerve	Lower posterolateral leg, heel and foot
Medial calcaneal nerve	Tibial nerve	Medial side and sole of heel
Medial and lateral plantar nerves	Tibial nerve	Sole of foot anterior to heel

Thigh:

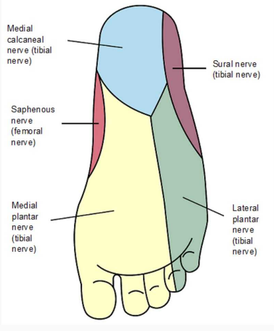
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- The obturator nerve supplies skin over the upper medial thigh.
- The posterior cutaneous nerve of the thigh, nerve from the sacral plexus, supplies skin over the posterior thigh and upper leg.

Leg:

- The saphenous nerve, branch of the femoral nerve, supplies the skin over the anteromedial knee, medial leg and the medial side of the foot as far anteriorly as the head of the 1st metatarsal.
- The lateral sural nerve, branch of the common fibular nerve, supplies the skin over the upper lateral leg.
- The superficial fibular nerve supplies the area of skin over the lower anterolateral leg and the dorsum of the foot (except for the webspace between the 1st and 2nd toe and the lateral side of the little toe).
- The deep fibular nerve supplies the skin over the webspace between the 1st and 2nd toe.
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- The medial calcaneal nerve, branch of the tibial nerve, supplies the skin over the medial side and sole of the heel.
- The medial and lateral plantar nerves, branches of the tibial nerve, supply the skin over the sole of the foot anterior of the heel.



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Anatomy: Hip and Thigh



Question 100 of 106

A 87 year old woman presents to the ED after her carers noted she was complaining of pain in the right groin. On examination you note a tender swelling in keeping with a femoral hernia. The femoral ring is bordered medially by which of the following structures:

a Fascia lata

b Femoral sheath

c Pectineal ligament

d Femoral vein

e Lacunar ligament

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Anatomy: Hip and Thigh

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a) Fascia lata
b) Femoral sheath
c) Pectineal ligament
d) Femoral vein
e) **Lacunar ligament** ✔

Answer

The femoral ring is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Notes

The femoral triangle is a wedge-shaped depression formed by muscles in the upper thigh at the junction between the anterior abdominal wall and the lower limb.

Femoral Triangle	Structure(s)
Superior border	Inguinal ligament
Lateral border	Medial sartorius muscle
Medial border	Medial adductor longus muscle
Roof	Fascia lata
Floor	Pectineus, iliopsoas and adductor longus muscles
Contents	Femoral nerve, femoral artery, femoral vein, femoral canal

Borders

The femoral triangle is bordered superiorly by the inguinal ligament, laterally by the medial border of the sartorius muscle and medially by the medial border of the adductor longus muscle. The roof is formed by the fascia lata and the floor is formed by the pectineus, iliopsoas and adductor longus muscles.

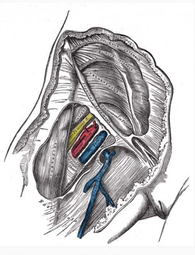
Contents

The femoral triangle contains (from lateral to medial):

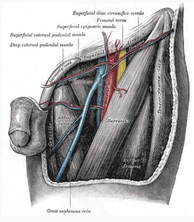
- The femoral nerve
- The femoral artery
- The femoral vein
- The femoral canal

Femoral sheath

The femoral sheath originates as a prolongation of extraperitoneal fascia and encloses the femoral artery, femoral vein and associated lymphatic vessels (contained within the femoral canal). The femoral nerve does NOT lie within the sheath, but instead lies lateral to it. The femoral sheath terminates inferiorly by blending with the adventitia of the femoral vessels approximately 4 cm inferior of the inguinal ligament.



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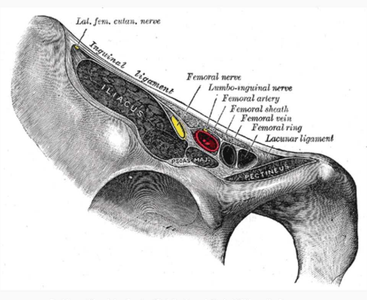
Femoral canal

The femoral canal lies between the medial edge of the femoral sheath and the femoral vein. The femoral canal contains loose connective tissue, lymphatic vessels, deep inguinal lymph nodes and empty space. The femoral canal allows the femoral vein to expand, for example, when venous return from the leg is increased, or when increased intra-abdominal pressure causes a temporary stasis.

Femoral ring

The femoral ring is formed by the proximal abdominal opening of the femoral canal, and is important clinically, as it is a common site of hernia. It is bordered anteriorly by the inguinal ligament, posteriorly by the pectineal ligament, medially by the lacunar ligament and laterally by the femoral vein.

Femoral ring	Structure(s)
Anterior border	Inguinal ligament
Posterior border	Pectineal ligament
Medial border	Lacunar ligament
Lateral border	Femoral vein



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Anatomy: Hip and Thigh



Question 101 of 106

A 54 year old woman presents with unilateral swelling of the left leg. Her d-dimer is normal and ultrasound has shown no demonstrable deep vein thrombosis. Your consultant has arranged for a CT of the leg and pelvis which shows lymphadenopathy of the deep inguinal lymph nodes. Which of the following best describes the location of the deep inguinal lymph nodes:

a Medial to the femoral vein in the femoral canal

b In a line superior to the inguinal ligament

c In a line inferior to the inguinal ligament

d Lateral to the femoral vein in the femoral canal

e Following the course of the external iliac vein

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Anatomy: Hip and Thigh

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a) **Medial to the femoral vein in the femoral canal** ✔
b) In a line superior to the inguinal ligament
c) In a line inferior to the inguinal ligament
d) Lateral to the femoral vein in the femoral canal
e) Following the course of the external iliac vein

Answer

The deep inguinal lymph nodes (about 1 – 3 in number) lie medial to the femoral vein within the femoral canal.

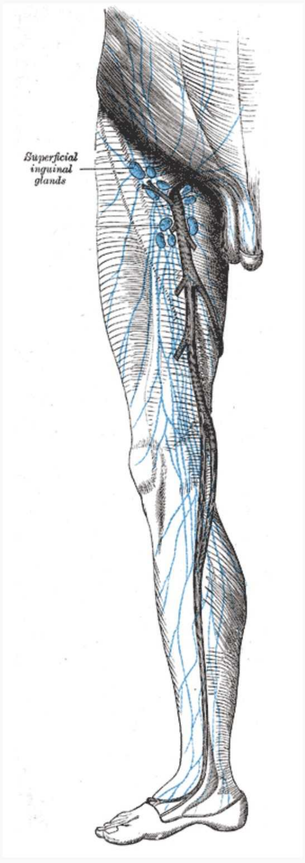
Notes

The inguinal nodes are found in the upper aspect of the femoral triangle.

The superficial inguinal lymph nodes (about 10 in number) are located in the superficial fascia, forming a line below the inguinal ligament, and medially extending inferiorly along the terminal part of the great saphenous vein. They receive lymph from the gluteal region, lower abdominal wall, perineum and superficial regions of the lower limb.

The deep inguinal lymph nodes (about 1 – 3 in number) lie medial to the femoral vein within the femoral canal. They receive lymph from deep lymphatics associated with the femoral vessels and from the glans penis or clitoris in the perineum.

The inguinal lymph nodes drain to the external iliac lymph nodes associated with the external iliac artery in the abdomen.



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Anatomy: Hip and Thigh



Question 102 of 106

A 43 year old window cleaner is brought to the ED after falling from a 5 metre platform. Imaging has shown multiple vertebral fractures and you are concerned about possible neurological injuries including the obturator nerve. Which of the following muscles is NOT innervated by the obturator nerve:

a Adductor longus

b Adductor brevis

c Adductor magnus

d Obturator externus

e Obturator internus

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Anatomy: Hip and Thigh

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a) Adductor longus
b) Adductor brevis
c) Adductor magnus
d) Obturator externus
e) **Obturator internus** ✔

Answer

The obturator nerve innervates all of the muscles in the medial compartment of the thigh, except for the pectineus and the hamstrings portion of the adductor magnus muscle. The obturator internus muscle is a deep gluteal muscle innervated by the nerve to the obturator internus.

Notes

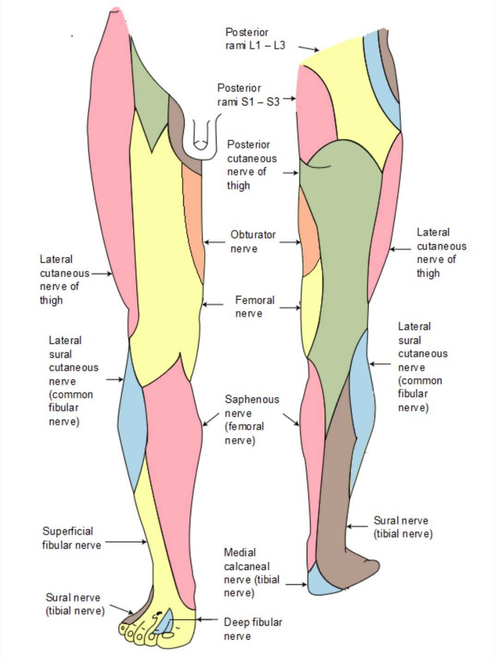
The obturator nerve arises from the lumbar plexus, formed from the anterior rami of L2 – L4.

Nerve	Obturator nerve
Nerve roots	L2 – L4
Motor supply	Medial thigh muscles (adductor longus, brevis and magnus, gracilis, obturator externus)
Sensory supply	Upper medial thigh
Motor loss in injury	Weak adduction of hip and difficulty walking with lateral swinging of limb during walking (due to unopposed abduction), loss of sensation over upper medial thigh

The obturator nerve descends along the posterior abdominal wall, passes through the pelvic cavity and enters the medial thigh by passing through the obturator canal.

The obturator nerve innervates all of the muscles of the medial compartment of the thigh (except for the hamstring part of the adductor longus, and the pectineus muscle which are innervated by the sciatic and the femoral nerves respectively). It also gives off a cutaneous branch that supplies skin on the medial side of the upper thigh.

Muscle	Action(s)
Adductor longus	Adduction and medial rotation at hip
Adductor brevis	Adduction and medial rotation at hip
Adductor magnus	Adduction and medial rotation at hip
Obturator externus	Lateral rotation at hip
Gracilis	Adduction at hip and flexion at knee



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Anatomy: Hip and Thigh



Question 103 of 106

A 25 year old man with haemophilia presents to the ED after falling onto his right hip. Plain x-ray reveals no bony injury. Concerned by his pain your consultant arranges a CT which shows an iliacus haematoma. The iliacus muscle primarily acts to perform which of the following movements:

a Flexion and abduction of the thigh

b Flexion of the thigh and flexion of the leg

c Flexion and medial rotation of the thigh

d Flexion and lateral rotation of the thigh

e Flexion and adduction of the thigh

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Anatomy: Hip and Thigh

Question 103 of 106

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a) Flexion and abduction of the thigh
b) Flexion of the thigh and flexion of the leg
c) Flexion and medial rotation of the thigh
d) **Flexion and lateral rotation of the thigh** ✔
e) Flexion and adduction of the thigh

Answer

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint.

Notes

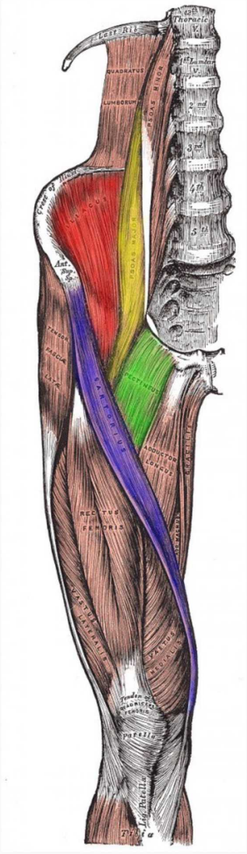
The sartorius, iliopsoas, pectineus and rectus femoris are the primary flexors of the thigh at the hip joint.

Muscle	Actions	Innervation
Sartorius (blue)	Flexion, abduction and lateral rotation at hip and flexion at knee	Femoral nerve (L2, L3)
Iliacus (red)	Flexion and lateral rotation at hip	Femoral nerve (L2, L3)
Psoas major (yellow)	Flexion and lateral rotation at hip	Anterior rami L1 – L3
Pectineus (green)	Adduction and flexion at hip	Femoral nerve (L2, L3)
Rectus femoris	Flexion at hip and extension at knee	Femoral nerve (L2 – L4)

The sartorius (blue) is innervated by the femoral nerve (L2, L3). It acts to flex the thigh at the hip joint and flex the leg at the knee joint. It also abducts the thigh and rotates it laterally, as when resting the foot on the opposite knee when sitting.

The iliacus (red) and psoas major (yellow) muscles originate as separate muscles but insert by a common tendon onto the femur and together are referred to as the iliopsoas muscle, which is a powerful flexor of the thigh at the hip joint and also contributes to lateral rotation of the thigh at the hip joint. The iliacus is innervated by the femoral nerve (L2, L3). The psoas major is innervated by the anterior rami of spinal nerves L1 – L3.

The pectineus (green) is innervated by the femoral nerve (L2, L3). It acts to adduct and flex the thigh at the hip joint.



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Anatomy: Hip and Thigh



Question 104 of 106

You are examining the lower limbs of a 54 year old man who presented after falling from a ladder at home. During your neurological assessment you note a weakness of hip flexion. Which of the following nerves is the most important for flexion of the thigh at the hip joint:

a Obturator nerve

b Femoral nerve

c Sciatic nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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Anatomy: Hip and Thigh

Question 104 of 106

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a) Obturator nerve
b) **Femoral nerve** ✔
c) Sciatic nerve
d) Superior gluteal nerve
e) Inferior gluteal nerve

Answer

Flexion of the thigh at the hip joint is produced by the sartorius, psoas major, iliacus and pectineus muscles, assisted by the rectus femoris muscle, all innervated by the femoral nerve (except for the psoas major, innervated by the anterior rami of L1 – 3).

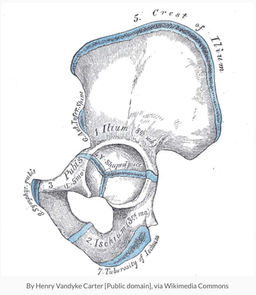
Notes

Joint	Hip joint
Type	Synovial ball and socket joint
Articulations	Head of femur with acetabulum of pelvis
Stabilising factors	Acetabular labrum, thickened fibrous capsule, extracapsular ligaments (iliofemoral, ischiofemoral, pubofemoral), medial rotator muscles (effectively 'pull' head of femur into acetabulum)
Movements	Flexion/Extension, Abduction/Adduction, Medial/Lateral rotation, Circumduction
Blood supply	Branches of obturator artery, medial and lateral circumflex branches of profunda femoris artery and superior and inferior gluteal arteries
Innervation	Femoral nerve, obturator nerve, superior gluteal nerve and nerve to the quadratus femoris

Joint articulations

The hip joint is a multiaxial synovial ball and socket joint occurring between the head of the femur and the acetabulum of the pelvis.

The acetabulum is formed by the fusion of the three bones, the ilium, the ischium and the pubis.

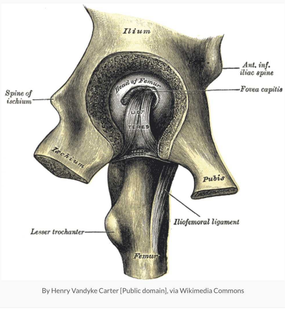


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The rim of the acetabulum is raised slightly by the fibrocartilaginous acetabular labrum which increases its depth, improving stability of the joint. The acetabular labrum continues inferiorly as the transverse acetabular ligament which bridges the acetabular notch and converts the notch into a foramen for the passage of nutrient vessels and nerves.

Ligaments

The intracapsular ligament of the head of femur (ligamentum teres) runs from the fovea on the head of the femur at one end to the acetabular fossa and the transverse acetabular ligament on the other. It carries a small acetabular branch of the obturator artery.



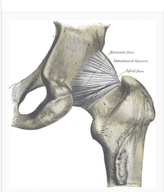
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There are three main stabilising extracapsular ligaments; the iliofemoral (the largest and strongest ligament), the pubofemoral and the ischiofemoral ligament.

- The iliofemoral ligament is anterosuperior to the hip joint, attached proximally to the ilium just below the anterior inferior iliac spine and distally to the intertrochanteric line of the femur. This ligament specifically prevents hyperextension and lateral rotation of the hip joint whilst standing.
- The pubofemoral ligament is anteroinferior to the hip joint, attached to the pelvis at the iliopubic eminence and adjacent bone and blending distally with the articular capsule. This ligament prevents excessive abduction and extension of the femur at the hip joint.
- The ischiofemoral ligament is posterior to the hip joint, attached medially to the ischium and laterally to the greater trochanter. This ligament prevents excessive extension and medial rotation of the femur at the hip joint.



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Blood supply

The hip joint receives its blood supply primarily from branches of the obturator artery, the medial and lateral circumflex arteries (branches of the profunda femoris artery) and the superior and inferior gluteal arteries. The articular branches of these vessels form a network around the joint.

Innervation

The hip joint is innervated by articular branches from the femoral nerve (anteriorly), obturator nerve (inferiorly), superior gluteal nerve (superiorly), and the nerve to the quadratus femoris (posteriorly).

Joint movements

The hip joint allows the movements of flexion and extension, abduction and adduction, medial and lateral rotation and circumduction.

Movement	Muscles Involved
Flexion	Sartorius, Iliacus, Psoas major, Pectineus, Rectus femoris
Extension	Hamstrings, Gluteus maximus
Abduction	Gluteus maximus, medius and minimus, Obturator internus, Gemelli, Piriformis, Sartorius
Adduction	Adductor longus, magnus and brevis, Gracilis, Pectineus
Medial rotation	Gluteus medius and minimus, Adductor longus, magnus and brevis, Semitendinosus and Semimembranosus
Lateral rotation	Obturator externus, Sartorius, Iliacus, Psoas major, Biceps femoris, Piriformis, Gluteus maximus, Obturator internus, Gemelli, Quadriceps femoris

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Anatomy: Hip and Thigh



Question 105 of 106

A patient presents to ED following a road traffic collision where they sustained a large force to their flexed leg against the dashboard. On examination, the tibia can be slid backwards under the distal femur. Which of the following structures has most likely been damaged:

a Tibial collateral ligament

b Oblique popliteal ligament

c Fibular collateral ligament

d Anterior cruciate ligament

e Posterior cruciate ligament

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Anatomy: Hip and Thigh

Question 105 of 106

A patient presents to ED following a road traffic collision where they sustained a large force to their flexed leg against the dashboard. On examination, the tibia can be slid backwards under the distal femur. Which of the following structures has most likely been damaged:

a) Tibial collateral ligament
b) Oblique popliteal ligament
c) Fibular collateral ligament
d) Anterior cruciate ligament
e) **Posterior cruciate ligament** ✔

Answer

This is the posterior drawer sign, seen in damage to the posterior cruciate ligament which normally acts to prevent posterior dislocation of the tibia on the femur. The ligament is lax during extension and taut during flexion and thus it may be torn in a hyperflexion injury, where a large force is applied to the tibia when the knee is flexed.

Notes

Joint	Knee joint
Type	Modified hinge synovial joint
Articulations	Femoral condyles with tibial condyles (tibiofemoral articulation) and patella with anterior femur (patellofemoral articulation)
Stabilising factors	Fibrous capsule, tibial spines, menisci, tibial/fibular collateral ligament, anterior/posterior cruciate ligament, vastus medialis and lateralis muscles, oblique popliteal ligament, iliotibial tract, muscle tendons (hamstrings, gastrocnemius, sartorius, gracilis)
Movements	Flexion/Extension, Medial/Lateral rotation in flexed position

Joint articulations

The knee joint is formed from two articulations:

- the main weight bearing tibiofemoral articulation between the two femoral condyles and the adjacent surfaces of the superior aspect of the tibial condyles
- the patellofemoral articulation between the anterior femur and the patella which allows the pull of the quadriceps femoris muscle to be directed anteriorly over the knee to the tibia without tendon wear

Joint movements

The knee joint is a modified hinge synovial joint, allowing mainly flexion and extension, but also a small degree of medial and lateral rotation.

Movement	Muscles Involved
Flexion	Hamstrings, Gracilis, Sartorius, Gastrocnemius, Plantaris
Extension	Quadriceps femoris

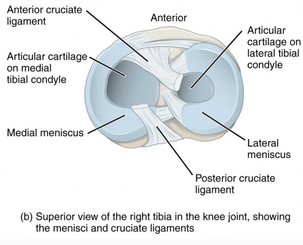
When standing, the knee joint is 'locked' in position to reduce the amount of muscle work needed to maintain the standing weight bearing position. This locking mechanism occurs partly due to the change in the shape/size of the articulating femoral surfaces (in the flexed position, the surfaces of the femoral condyles that articulate with the tibia are curved/round, but in extension, the surfaces are flat, and consequently the joint surfaces become larger and more stable in extension) and partly due to medial rotation of the femur on the tibia in full extension; medial rotation and full extension tightens all the associated ligaments (the screw home mechanism). Contraction of the popliteus muscle 'unlocks' the knee by initiating lateral rotation of the femur on the tibia, and allowing flexion.

Joint capsule

The fibrous membrane of the knee joint is reinforced anteriorly by the tendinous expansions of the vastus lateralis and vastus medialis muscles, anterolaterally by a fibrous extension from the iliotibial tract and posteromedially by the oblique popliteal ligament, an extension from the tendon of the semimembranosus muscle (the oblique popliteal ligament resists hyperextension and lateral rotation of the leg). The upper end of the popliteus muscle passes through an opening in the posterolateral aspect of the fibrous membrane of the knee.

Menisci

The two menisci are C-shaped fibrocartilaginous structures that lie between the femoral condyles and the tibia, attaching at each end to facets in the intercondylar region of the tibial plateau. In addition, the medial meniscus is also attached around its margin to the joint capsule and to the tibial collateral ligament, unlike the smaller, more mobile lateral meniscus. This means any damage to the tibial collateral ligament results in tearing of the medial meniscus. The menisci deepen the articular surface of the tibia increasing stability of the joint, improve congruence between the femoral and tibial condyles during joint movements and play an important role in shock absorption.



(b) Superior view of the right tibia in the knee joint, showing the menisci and cruciate ligaments

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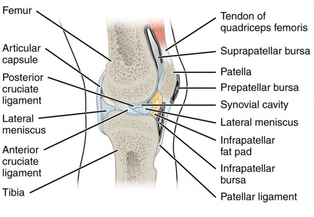
Ligaments

The tibial collateral ligament is attached proximally to the medial epicondyle of the femur and distally to the medial tibia. The fibular collateral ligament is attached proximally to the lateral condyle of the femur and distally to the lateral fibula. The tibial and fibular collateral ligaments act to stabilise the knee joint medially and laterally respectively, limiting extension and preventing adduction and abduction movements. The tibial collateral ligament is also attached to the medial meniscus; this means any damage to the tibial collateral ligament usually results in tearing of the medial meniscus.

The cruciate ligaments interconnect the adjacent ends of the femur and tibia and maintain their opposed positions during movement.

- The anterior cruciate ligament (the weaker of the two) attaches to the anterior part of the intercondylar area of the tibia and ascends posteriorly to attach to the lateral wall of the intercondylar fossa of the femur and acts to prevent anterior displacement of the tibia relative to the femur. The ligament is lax during flexion and taut during extension thus it may be torn when the knee is hyperextended (or by the application of a large force to the back of the knee with the joint partly flexed). The anterior drawer sign may be seen where there is forward sliding of the tibia on the femur.
- The posterior cruciate ligament (the stronger of the two) attaches to the posterior part of the intercondylar area of the tibia and ascends anteriorly to attach to the medial wall of the intercondylar fossa of the femur and acts to prevent posterior dislocation of the tibia relative to the femur. The ligament is lax during extension and taut during flexion and thus it may be torn in a hyperflexion injury, where a large force is applied to the tibia when the knee is flexed. The posterior drawer sign may be seen where there is backward sliding of the tibia on the femur.

The 'unhappy triad' typically occurs due to a lateral force to an extended knee, e.g. in a football tackle. It refers to injury of the anterior cruciate ligament (due to forward displacement of the tibia), the tibial collateral ligament (due to excessive abduction) and the medial meniscus (due to its attachment on the tibial collateral ligament).



(a) Sagittal section through the right knee joint

Bursae

The synovial membrane of the knee joint forms pouches in two locations to provide low-friction surfaces for the movement of tendons associated with the joint:

- The subpopliteal recess – extends posterolaterally and lies between the lateral meniscus and the tendon of the popliteus muscle
- The suprapatellar bursa extends superiorly between the distal end of the shaft of the femur and the quadriceps femoris muscle and tendon

Other bursae associated with the knee, but not normally communicating with the synovial joint, include the subcutaneous prepatellar bursa, the deep and subcutaneous infrapatellar bursae separated by the patella ligament, and numerous other bursae associated with tendons and ligaments around the knee joint. Housemaid's knee is inflammation of the prepatellar bursa, and Clergyman's knee is inflammation of the subcutaneous infrapatellar bursa.

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MENU

Anatomy: Hip and Thigh



Question 106 of 106

A 19 year old man self presents to the ED following a fight in a nearby street. He has sustained multiple stab wounds and lacerations to the upper thigh and buttocks. Imaging shows an injury to the nerve supplying the obturator externus muscle. Which nerve has been injured:

a Femoral nerve

b Obturator nerve

c Sciatic nerve

d Superior gluteal nerve

e Inferior gluteal nerve

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